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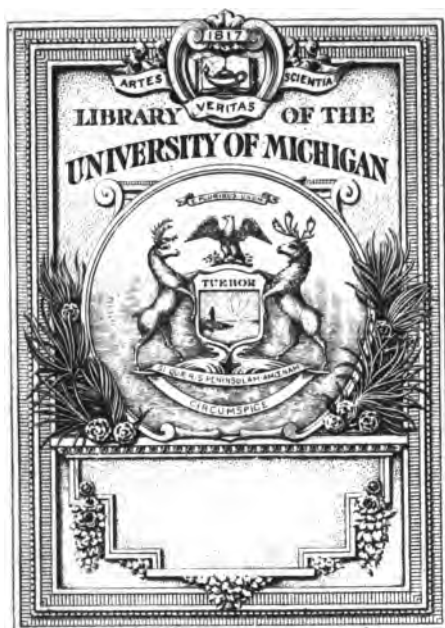
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METROPOLITAN WATER AND SEWERAGE BOARD

FOURTEENTH ANNUAL REPORT

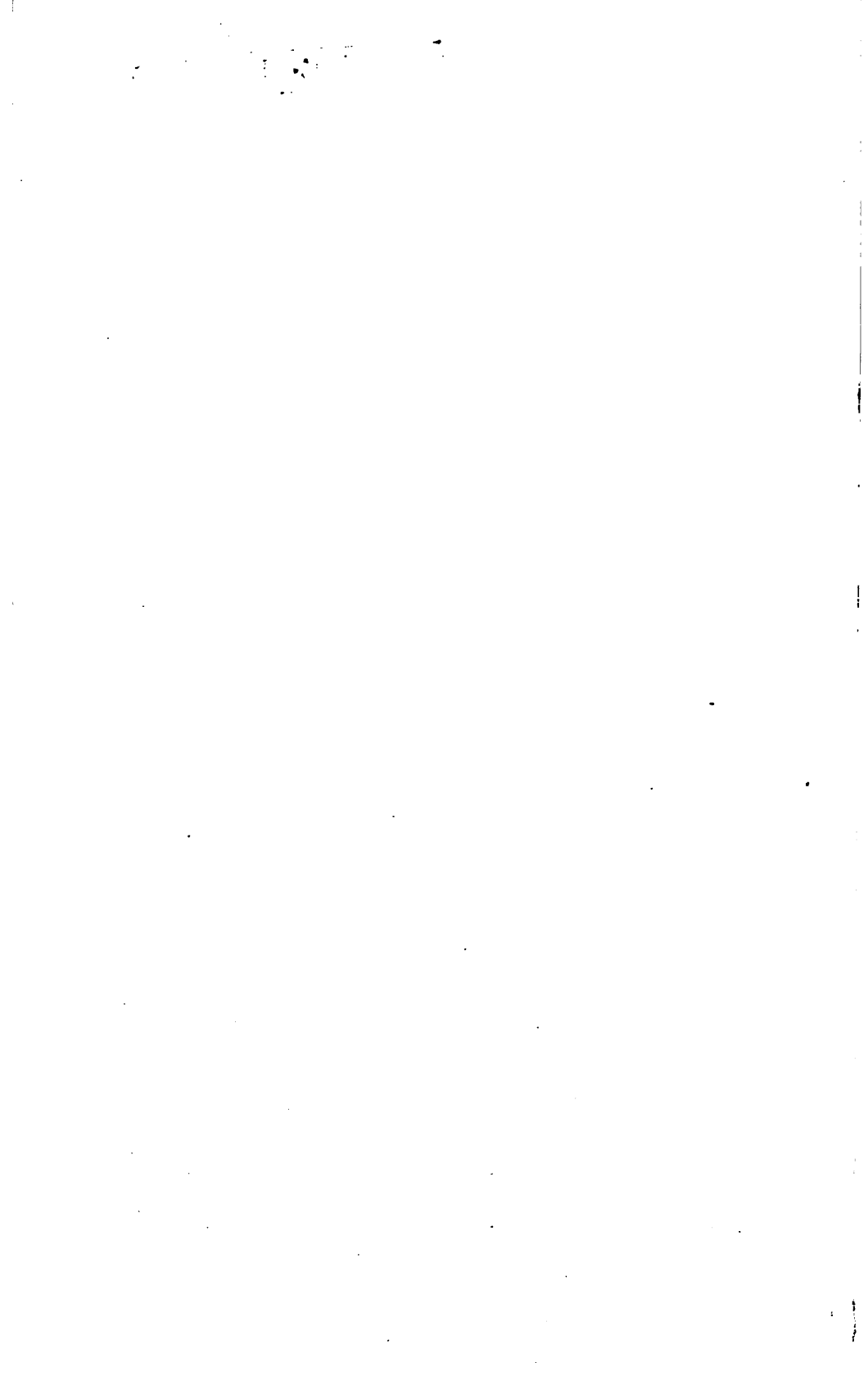
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FOURTEENTH ANNUAL REPORT

OF THE

Massachusetts

METROPOLITAN WATER AND SEWERAGE BOARD.

FOR THE YEAR 1914.



BOSTON:
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METROPOLITAN WATER AND SEWERAGE BOARD.

To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The Metropolitan Water and Sewerage Board, established under the provisions of chapter 168 of the Acts of the year 1901, has already presented to your Honorable Body an abstract of the account of its receipts, expenditures, disbursements, assets and liabilities for the fiscal year ending on November 30, 1914, and now, in accordance with the provisions of chapter 235 of the Acts of the year 1906, presents a detailed statement of its doings for the calendar year ending on December 31, 1914, being its

FOURTEENTH ANNUAL REPORT.

I. ORGANIZATION AND ADMINISTRATION.

BOARD, OFFICERS AND EMPLOYEES.

The term of office of Henry P. Walcott expired on March 20, and he was reappointed for the term of three years next succeeding. Mr. Henry H. Sprague resigned in January and Mr. Thomas E. Dwyer was appointed on January 23 for the unexpired term, ending March 20, 1915. Dr. Walcott was designated chairman of the Board. At the end of the year the Board consisted of Henry P. Walcott, chairman, Edward A. McLaughlin and Thomas E. Dwyer. William N. Davenport has continued as secretary. Alfred F. Bridgman has been the purchasing agent and Miss Alice G. Mason the bookkeeper.

There are also employed in the administrative office a paymaster, an assistant in auditing, two general clerks, three stenographers and clerks, a telephone operator, and a janitor with two assistants, both of whom act as watchmen.

Such general conveyancing work and investigation of real estate titles in the different counties as have been called for during the year have been performed by George D. Bigelow.

The consulting engineers of the Board are Hiram F. Mills and Frederic P. Stearns, who are called upon for services when matters arise which require their consideration.

Dexter Brackett, Chief Engineer of the Water Works, has had supervision over the various departments of both construction and maintenance of the Water Works. William E. Foss has been Assistant to the Chief Engineer. The following have also continued as superintendents of departments under the direction of the Chief Engineer: Elliot R. B. Allardice, Superintendent of the Wachusett Department; Charles E. Haberstroh, Superintendent of the Sudbury and Cochituate Works and of the portion of the Weston Aqueduct above the Weston Reservoir; Samuel E. Killam, Superintendent in charge of the Weston Reservoir and the remaining portion of the Weston Aqueduct, and of all reservoirs and pipe lines within the Metropolitan District; and Arthur E. O'Neil, Superintendent of the several pumping stations.

The average engineering force employed on construction and maintenance during the year has included, in addition to the Chief Engineer, 4 department superintendents, 2 division engineers, 8 assistant engineers and 28 others in various engineering capacities and as sanitary inspectors, clerks, stenographers and messengers, the total force numbering 43.

A maintenance force in addition to those engaged in engineering capacities, as above mentioned, numbering upon the average during the year 244, has been required at the pumping stations, upon reservoirs, aqueducts, pipe lines and upon minor construction work. At the end of the year this force numbered 233.

Frederick D. Smith, Engineer of Sewerage Works, has had charge of both construction and maintenance of the works. He has been assisted by Henry T. Stiff, Division Engineer in charge of the office and drafting, by 2 assistant engineers and by 10 others employed in different engineering capacities, and by 2 stenographers and clerks.

The maximum engineering force employed at any one time during the year on the construction and maintenance of the Sewerage Works was 15.

The regular maintenance force required in addition for the operation of the pumping stations, the care and inspection of the sewers,

and for other parts of the Sewerage Works, exclusive of the engineers and day-labor forces, on the average has been 165.

The whole regular force of the Sewerage Department at the end of the year numbered 180, of whom the Engineer and 14 assistants and draftsmen were engaged in general upon the works, and of the remainder, 101 were employed upon the North System and 64 upon the South System.

The maximum number of men employed upon contracts and upon day-labor construction on the Sewerage Works during the year was for the week ending June 27, when the number amounted to 125.

II. METROPOLITAN WATER DISTRICT.

The Metropolitan Water District now comprises the cities of Boston, Chelsea, Everett, Malden, Medford, Melrose, Newton, Quincy and Somerville, and the towns of Arlington, Belmont, Lexington, Milton, Nahant, Revere, Stoneham, Swampscott, Watertown and Winthrop, — in all 9 cities and 10 towns. The District has an area of 174.8 square miles, no additional municipalities having been admitted into the District during the year. Its population, according to the United States Census taken for April 1, 1910, was 1,070,256. The population of the District on July 1, 1914, the date upon which calculations for the Water Works are based, was estimated as 1,177,770.

III. METROPOLITAN WATER WORKS — CONSTRUCTION.

The total amount expended for the construction and acquisition of the Metropolitan Water Works since the passage of the Metropolitan Water Act in the year 1895 has been \$42,414,140.55.

The total amount expended during the calendar year on account of the construction and acquisition of works has been \$177,397.02. The details of this expenditure are as follows: on account of the construction of a steel tank or reservoir on Bellevue Hill with connecting pipe lines and the reinforcement of the southern high-service pipe lines in Milton, the sum of \$94,711.75; for the work on lowering water pipes in Chelsea Creek, \$53,259.15; for the preliminary work on account of the power plant at Sudbury Dam and the improvement of Beaver Dam Brook, the sums of \$781.35 and \$158.58, respectively; for the construction of the Hyde Park pumping sta-

tion, the sum of \$1,751.08; for stock on hand, \$18,487.02; and for other minor works, engineering and administration expenses, the sum of \$8,248.09.

The construction of the tunnel under Chelsea Creek between Chelsea and East Boston, in which to place a 42-inch cast-iron water main for use in supplying water to the East Boston district, was finished on December 31. The work remaining to be done consists in making connections with existing mains in Chelsea and East Boston and removing the two 24-inch mains now in the channel. This work has been done within the appropriation made by the Legislature.

The laying of a 24-inch pipe line from the Lower Mills in Dorchester, through Adams Street in Milton and Quincy to the junction of Adams and Beale streets in the last-named city, for a distance of 13,000 feet, was begun during the past summer and will be finished during the early part of the coming season, this pipe line being laid to reinforce the existing single 24-inch main in case of extraordinary draft or in case of accident.

The standpipe on Bellevue Hill, used in connection with the pumping station at Hyde Park in supplying water to the higher lands in West Roxbury, Hyde Park and Milton, has a storage capacity of only 135,000 gallons. To provide a more adequate storage, the construction of a larger reservoir with a capacity of 2,500,000 gallons and the laying of a new 20-inch pipe line, connecting the pumping station with the above-mentioned reservoir, was begun during the year and the pipe line and the steel tank are completed. It remains to build the surrounding structure of granite, which it is expected will be completed during the coming season.

Under authority granted in 1909, the Board in the years 1909 and 1910 laid 17,854 feet of 60-inch cast-iron pipe, extending from a point on Commonwealth Avenue near Valentine Street, in Newton, to Cleveland Circle near Chestnut Hill Reservoir, and the completion of the line to the Charles River, a further distance of 14,520 feet, was at that time deferred. In order to take advantage of the present favorable time for the completion of this work, contracts were made for the pipe and special castings needed for the work. About 240 tons of the pipe for this work had been delivered at the close of the year, and contracts will be made for laying the pipes early in the coming season.

Chapter 601 of the Acts of 1914 authorized the expenditure of \$80,000 in constructing a hydro-electric plant at the Sudbury Dam, in Southborough, to be used in developing electric energy and thus conserving the power in the water previous to its use in the Metropolitan District.

Before installing the necessary machinery it was deemed expedient to make a contract for the sale of the energy. Bids were received on September 2, and a contract has been made with the Edison Electric Illuminating Company of Boston, which provides that for a term of five years that Company will take and pay \$6.25 per thousand kilowatt hours for all energy delivered to its lines at a point near the Sudbury Dam. Plans and specifications for the construction and installation of the necessary machinery are now practically finished and proposals will soon be received for doing the work.

The City Engineer of Worcester and the Chief Engineer of the Metropolitan Water Works, acting as arbitrators under the terms of the legislative act authorizing the city of Worcester to divert the water from a portion of the Wachusett watershed, have made a report which has been accepted by the city, and the amount of the award with interest will be paid early in the present year.

During the year easements in 0.862 of an acre of land were acquired for the Water Works.

IV. WATER WORKS — MAINTENANCE.

The maintenance and operation of the Metropolitan Water Works during the past calendar year have required the expenditure of \$413,078.95.

(1) STORAGE RESERVOIRS.

The water in the Wachusett Reservoir reached its highest elevation, 395.43, on April 1.

The Sudbury Reservoir, Framingham Reservoir No. 3 and Lake Cochituate, from which water is discharged into the Weston, Sudbury and Cochituate aqueducts, have been kept nearly full during the year.

It has not been necessary to draw water for the supply of the Metropolitan District from Framingham Reservoir No. 1, Framingham Reservoir No. 2, Farm Pond, Ashland, Hopkinton and

Whitehall reservoirs and Lake Cochituate, but water has been discharged from Framingham Reservoir No. 1 and Framingham Reservoir No. 2 into Farm Pond, from which the town of Framingham obtains indirectly most of its supply.

(2) AQUEDUCTS.

The Wachusett Aqueduct was in service for the passage of water from the Wachusett Reservoir to the Sudbury Reservoir during the whole or portions of 291 days. The quantity of water flowing through the aqueduct was equal to an average of 92,420,000 gallons per day for the entire year. Of the total quantity of water admitted to the aqueduct 98 per cent. was used before its admission for the development of electric energy.

For distribution to the cities and towns of the Metropolitan Water District water was drawn through the Sudbury Aqueduct to the Chestnut Hill Reservoir during portions of every day in the year, the daily average for the whole year being 67,564,000 gallons.

The Weston Aqueduct was in use during the entire year, the quantity of water delivered through the aqueduct being equivalent to a daily average of 37,643,000 gallons.

(3) PUMPING STATIONS.

During the year 65 per cent. of the water furnished for distribution to the Metropolitan Water District was pumped at the two Chestnut Hill stations. The remaining 35 per cent. of the water was distributed by gravity, this proportion being 2 per cent. greater than in 1913. Other pumping at the Spot Pond, Arlington and Hyde Park pumping stations has been required for supplying the higher portions of the District.

The average quantity pumped per day at the Chestnut Hill stations was 69,930,000 gallons, at the Spot Pond station 7,367,000 gallons, at the Arlington station 718,000 gallons and at the Hyde Park station 700,000 gallons, a total of 78,715,000 gallons per day.

The following are the several pumping stations:—

	Number of Engines.	Contract Capacity per Day (Gallons).	Lift (Feet).
Chestnut Hill high-service station,	4	66,000,000	138
Chestnut Hill low-service station,	3	105,000,000	60
Chestnut Hill low-service station,	1	40,000,000	130
Spot Pond station,	2	30,000,000	125
Arlington station,	2	3,000,000	290
Hyde Park station,	2	6,000,000	140

The cost of operating the stations was \$104,806.20, equivalent to \$3.648 per million gallons pumped. The total cost is somewhat more than for the year 1913, the cost per million gallons showing an increase of \$0.224, owing to an increase in cost of repairs.

The total amount of coal purchased during the year was 7,796.53 gross tons, of which 6,919.93 tons were bituminous and 876.60 tons anthracite. All of the anthracite coal was buckwheat and screenings. The cost of bituminous coal delivered in the bins at the various stations varied from \$4 to \$5.13, and the cost of anthracite coal varied from \$2.50 to \$3.16 per ton.

(4) PIPE LINES.

Greater even than the ordinary deterioration of water pipes by reason of rust have been the dangers from electrolytic action. Careful examinations made during the past year show in various parts of the system an improved condition in the amount of electrolytic action upon the main pipes, and while the danger from this source is by no means obviated, it is believed that the practice of making insulating joints at intervals of about 500 feet in all new pipe lines will have the effect of materially reducing the danger to the pipe system from this source. The question of the legal responsibility for the damage hitherto inflicted upon the water pipes of the Metropolitan System has not yet been definitely settled and is still under consideration by the legal authorities of the State.

(5) PROTECTION OF THE WATER SUPPLY.

The Marlborough Brook filter-beds, on which is filtered the water received from brooks passing through the thickly settled portions

of Marlborough, have been adequate for the filtration of all the water received.

The Pegan Brook pumping station, at which is pumped upon the filter-beds the surface drainage of about one square mile in the thickly settled portion of Natick, was in operation 256 days in the year.

The filter-beds which receive for filtration the water flowing through the thickly settled portion of the town of Sterling, as well as the smaller filter-beds which receive the drainage from a few houses near Sterling Junction, the Worcester County Training School at West Boylston and from the swimming pool at Southborough, have been in successful operation and required only the usual attention during the year.

Studies for the disposal of manufacturing wastes, as well as for the disposal of house drainage from the various towns within the drainage area of the Metropolitan Water System, have been in progress during the year.

Constant inspection of the watersheds is maintained by the Sanitary Inspector and his assistants and members of the maintenance force.

Chemical examinations of the waters used were made by the State Board of Health and the State Department of Health, and in addition, microscopical and bacterial examinations were made by this Board. These examinations enable the Board to take measures to remedy any difficulties which are found to exist.

The quality of the water brought to the Metropolitan District continues to be satisfactory both in taste and in appearance. This condition results in a large measure from the fact that it is still possible to reject some of the sources which were in use before the extension of the water works to the South Branch of the Nashua River at Clinton. The water derived from the Wachusett watershed has been of superior quality to that coming from the Sudbury and Cochituate sources. The first-named supply, so far as possible, has been that conveyed to the District; the others have been wasted to a greater or less extent as occasion has permitted.

The time, however, is approaching when all the sources will be required for the supply of the District. When that day arrives it will be necessary, without doubt, to filter these inferior waters in order to bring them to the standard of excellence to which the

District has become accustomed since the establishment of the Metropolitan water supply.

The subject of adequate filtration has been carefully considered, and whenever the need of such treatment becomes urgent, the Board will be in a position at once to construct the necessary works.

(6) CLINTON SEWERAGE WORKS.

For the purpose of removing a possible nuisance in the Nashua River below Clinton, a filtration area was established in South Lancaster just north of the Clinton boundary line. All of the sewage of Clinton, which had hitherto directly entered the South Branch of the Nashua River, has been pumped to this filtration field since September 15, 1899. The method of operating this filtration plant has from the beginning been carried out strictly in accordance with the best practice of the day, and the beds to-day are probably in better condition than any similar disposal area in the State. The purification of the effluent from the beds is now entirely satisfactory. It is still true, however, that during certain hours of the sultry days of summer there is an appreciable nuisance occasioned by some of the processes now employed in sewage filtration. It is evident to the Board that these processes, which occasion a certain amount of disagreeable odor, may be so far changed that no serious interference with the public comfort need take place in the future. The offensive odors do not appear, however, at any time to have gone to any considerable distance beyond the highway which skirts one side of the area devoted to filtration purposes. It is confidently expected that the changes and improvements now proposed in the arrangement of these works will be completed before the season when complaint has usually arisen with regard to offensive odors proceeding from these beds.

(7) FORESTRY.

During the past ten years over 1,500,000 white pine and spruce seedlings have been planted on more than 1,313 acres of land owned by the Board in the vicinity of the Wachusett Reservoir, and there remain about 600 acres on the Wachusett watershed to be planted. It is also planned to plant pines on about 800 acres of land in the vicinity of the reservoirs on the Sudbury River watershed. During

the year 99,300 white pine seedlings have been planted on this area in the vicinity of the Sudbury Reservoir. The wooded areas upon the watersheds have received the attention necessary to preserve and improve the growth already in existence there.

The ravages of the gypsy and brown-tail moths and of the elm-leaf beetle have continued during the year, requiring a large amount of work and considerable expense to protect the trees on lands controlled by the Board. The egg clusters of the gypsy moth have been painted with creosote and nests of the brown-tail moths destroyed by burning, and extensive spraying has been required for the preservation of trees infested by moths and elm-leaf beetles.

(8) WACHUSETT POWER PLANT.

The hydro-electric power station at the Wachusett Dam was operated on 286 days during the year. The daily output varied from the minimum amount which the Connecticut River Transmission Company is required to take under its contract, to the full capacity of the plant. The operation of the plant has been entirely successful, the gross earnings for the year being \$38,004.69. The cost of operating the plant has been \$8,969.46, the net earnings, \$29,035.23 and the net earnings per thousand kilowatt hours generated, \$4.052.

(9) RAINFALL AND WATER SUPPLY.

The rainfall is still below the average, and somewhat less than in the preceding year. On the Wachusett watershed the rainfall was 38.54 inches and on the Sudbury watershed 37.71 inches, while the averages for the periods covered by the records have been, respectively, 45.43 inches and 44.81 inches.

The Wachusett watershed yielded a daily average of 1,445,000 gallons of water per square mile, and the Sudbury watershed yielded a daily average of 772,000 gallons. The Wachusett watershed yielded a daily average of 1,073,000 gallons per square mile, for the 18 years during which measurements have been made, and the daily average per square mile from the Sudbury watershed during the 40 years for which records have been kept has been 995,000 gallons.

(10) WATER CONSUMPTION.

During the year the quantity of water supplied to the Metropolitan Water District amounted to a daily average of 107,036,100 gallons, which was equivalent to 94 gallons for each person in the District. This quantity was 3,188,400 gallons more than the average daily consumption of the preceding year.

Acting under the authority conferred by several statutes and arrangements which have been made, water has been supplied to a limited extent outside of the Metropolitan Water District. There has been drawn from the open channel of the Wachusett Aqueduct for the use of the Westborough State Hospital a daily average quantity of 183,000 gallons. The town of Framingham has, under the provision of the statute, drawn indirectly from Farm Pond a daily average quantity of 692,877 gallons and directly from the Sudbury Aqueduct 113,427 gallons. A portion of the town of Saugus has been supplied through the town of Revere with an average of 13,700 gallons daily. The United States Government, for use on Peddock's Island, has been supplied with a daily average of 109,000 gallons, and a daily average of 305,300 gallons has been furnished the town of Wakefield as an emergency supply. The sums charged for the water thus supplied have amounted to \$14,068.60.

V. WATER WORKS—FINANCIAL STATEMENT.

The financial abstract of the receipts, disbursements, assets and liabilities of the Board for the State fiscal year, beginning with December 1, 1913, and ending with November 30, 1914, was, in accordance with the requirements of chapter 235 of the Acts of the year 1906, presented to the General Court in January last, and a copy of this financial abstract is printed as Appendix No. 5.

As required by said chapter a detailed statement of its doings for the calendar year 1914, in relation to the Metropolitan Water Works, is herewith presented.

CONSTRUCTION.

(1) WATER LOANS — RECEIPTS AND PAYMENTS.

Total loans authorized to January 1, 1915, \$42,798,000 00¹

Receipts from the sales of property applicable to the construction and acquisition of works: —

For the period prior to January 1, 1914, . \$234,177 74

For the year ending December 31, 1914, . 8,749 26

242,927 00

Receipt from town of Swampscott for admission to District (St. 1909, c. 320), 90,000 00

Total amount authorized to January 1, 1915, . . . \$43,130,927 00

Amounts approved by Board for payments out of Water Loan Fund: —

Payments prior to January 1, 1914, . \$42,236,743 53

Approved for year ending December 31,

1914, 177,397 02

42,414,140 55

Amount authorized but not expended January 1, 1915, . \$716,786 45

(2) TOTAL WATER DEBT, DECEMBER 31, 1914.

Water Loan Outstanding, Sinking Fund and Debt.

Bonds issued by the Treasurer of the Commonwealth: —

Sinking fund bonds (3 and 3½ per cent.), \$41,398,000 00

Serial bonds (3½ and 4 per cent.), 648,000 00

Total bond issue to December 31, 1914, \$42,046,000 00

Serial bonds paid prior to January 1, 1914, . . \$15,000 00

Serial bonds paid in 1914, 10,000 00

25,000 00

Total bond issue outstanding December 31, 1914, . . \$42,021,000 00

Gross Water Debt, \$42,021,000 00

Sinking fund December 31, 1914, 11,533,453 45

Net Water Debt December 31, 1914, \$30,487,546 55

A decrease for the year of \$667,751.77.

¹ Included in this amount is \$254,000, appropriated by chapter 601, Acts of 1914, for constructing a 24-inch main from River Street in Dorchester through Milton to Quincy; a reservoir on Bellevue Hill in Boston; a 20-inch force main to said reservoir; and an electric power plant at Sudbury Dam.

(3) METROPOLITAN WATER LOAN AND SINKING FUND,
DECEMBER 31, 1914.

YEAR.	Authorized Loans.	Bonds issued (Sinking Fund).	Bonds issued (Serial Bonds).	Sinking Fund.
1895,	\$27,000,000	\$5,000,000	-	\$226,286 05
1896,	-	2,000,000	-	699,860 70
1897,	-	6,000,000	-	954,469 00
1898,	-	4,000,000	-	1,416,374 29
1899,	-	3,000,000	-	1,349,332 97
1900,	-	1,000,000	-	1,573,619 72
1901,	13,000,000	10,000,000	-	1,662,426 95
1902,	-	3,500,000	-	2,256,803 81
1903,	-	1,500,000	-	2,877,835 59
1904,	-	2,500,000	-	3,519,602 92
1905,	-	650,000	-	4,207,045 69
1906,	500,000	1,350,000	-	4,897,822 62
1907,	-	-	-	5,643,575 69
1908,	398,000	-	-	6,419,283 28
1909,	900,000	398,000	-	7,226,262 31
1910,	80,000	500,000	-	8,089,902 91
1911,	212,000	-	\$200,000	8,953,437 44
1912,	600,000	-	190,000	9,829,356 80
1913,	108,000	-	-	10,767,701 68
1914,	-	-	258,000	11,533,453 45
	\$42,798,000	\$41,398,000	\$648,000	

(4) WATER ASSESSMENT, 1914.

The following water assessment was made by the Treasurer of the Commonwealth upon the various municipalities: —

Sinking fund requirements,	\$280,333 00
Serial bonds,	\$17,000 00
Less premium,	13,431 75
	<hr/>
	3,568 25
Interest,	1,444,806 05
Maintenance: —	
Appropriated by Legislature,	\$450,551 91
Less balance on hand,	6,303 25
	<hr/>
	444,248 66
Total water assessment for 1914,	<hr/>
	\$2,172,955 96

In accordance with chapter 488, Acts of 1895, as amended in 1901, 1904 and 1906, the proportion to be paid by each city and town is based one-third in proportion to their respective valuations and the remaining two-thirds in proportion to their respective water consumption for the preceding year, except that but one-fifth of the total valuation and no consumption has been taken for the city of Newton, as it has not been supplied with water from the Metropolitan works.

The division of the assessment for 1914 was as follows:—

CITIES AND TOWNS.	Assessment.	CITIES AND TOWNS.	Assessment.
Arlington,	\$16,583 29	Nahant,	\$5,755 70
Belmont,	9,583 11	Newton,	6,221 66
Boston,	1,676,038 11	Quincy,	51,469 66
Chelsea,	50,869 84	Revere,	27,021 39
Everett,	45,438 12	Somerville,	109,999 13
Lexington,	8,242 15	Stoneham,	7,777 36
Malden,	46,596 27	Swampscott,	10,810 32
Medford,	27,914 48	Watertown,	18,688 47
Melrose,	22,647 92	Winthrop,	15,404 73
Milton,	15,894 25		\$2,172,955 96

(5) SUPPLYING WATER TO CITIES AND TOWNS OUTSIDE OF DISTRICT AND TO WATER COMPANIES.

Sums have been received during the year 1914 under the provisions of the Metropolitan Water Act, for water furnished, as follows:—

Town of Framingham,	\$690 69
Town of Revere (on account of water furnished to a portion of the town of Saugus for 1913),	280 00
United States Government (for Peddock's Island),	2,463 15
Westborough State Hospital,	1,992 66
	<hr/>
	\$5,426 50

The sums so received prior to March 23, 1907, were annually distributed among the cities and towns of the District; but since that date, in accordance with the provisions of chapter 238 of the Acts of 1907, the sums so received have been paid into the sinking fund.

(6) EXPENDITURES FOR THE DIFFERENT WORKS.

The following is a summary of the expenditures made in the various operations for the different works: —

CONSTRUCTION AND ACQUISITION OF WORKS.	For the Year ending December 31, 1914.
Administration applicable to all parts of the construction and acquisition of the works,	\$5,668 20
Wauchusett Department,	1,401 41
Beaver Dam Brook improvement,	158 58
Power Plant at Sudbury Dam,	781 35
Distribution system: —	
Low service: —	
Lowering pipe at Chelsea Creek,	\$53,259 15
Northern extra high service: —	
Pipe lines and connections,	107 89
Southern high service: —	
Section 43 (24-inch main in Dorchester through Milton to Quincy),	48,367 31
Southern extra high service: —	
Section 42 (20-inch main to reservoir on Bellevue Hill),	21,926 33
Bellevue Reservoir on Bellevue Hill in Boston,	24,394 31
Legal services,	23 80
Hyde Park pumping station,	1,751 08
Weston Aqueduct supply mains,	327 52
Meters and connections,	706 07
	150,863 46
Stock — pipes, valves, castings, etc., purchased and sent first to storage yards, and later transferred, as needed, to the various parts of the work: —	
Amount received,	\$59,838 85
Transferred from storage yards to the various sections of the work and included in costs of special works,	41,351 83
	18,487 02
Acquisition of existing water works: —	
Legal and expert expenses,	37 00
	\$177,397 02
Amount charged from beginning of work to January 1, 1914,	42,236,743 53
Total for construction and acquisition of works to January 1, 1915,	\$42,414,140 55

MAINTENANCE AND OPERATION.	For the Year ending December 31, 1914.	
Administration,		\$13,129 75
General supervision,		28,809 64
Taxes and other expenses,		44,247 40
Wachusett Department: —		
Superintendence,	\$9,009 04	
Reservoir,	8,511 99	
Forestry,	11,916 80	
Protection of supply,	3,082 82	
Buildings and grounds,	3,632 97	
Wachusett Dam,	3,760 77	
Wachusett Aqueduct,	5,657 89	
Clinton sewerage system: —		
Pumping station,	1,823 90	
Sewers, screens and filter-beds,	4,577 91	
Sanitary inspection,	2,058 60	
Swamp drainage,	2,753 27	
Power plant,	5,881 96	
		62,668 01
Sudbury Department: —		
Superintendence, Framingham office,	\$11,062 40	
Ashland Reservoir,	1,900 02	
Hopkinton Reservoir,	1,840 61	
Whitehall Reservoir,	639 84	
Framingham Reservoirs Nos. 1, 2 and 3,	5,725 77	
Sudbury Reservoir,	5,605 50	
Lake Cochituate,	4,902 45	
Marlborough Brook filters,	3,011 43	
Pegan filters,	4,956 75	
Sudbury and Cochituate watersheds,	2,160 78	
Sanitary inspection,	3,067 62	
Cochituate Aqueduct,	2,808 32	
Sudbury Aqueduct,	5,306 90	
Weston Aqueduct,	4,981 44	
Forestry,	8,557 09	
Improvement and protection of water supplies,	1,300 75	
		67,827 67
Distribution Department: —		
Superintendence,	\$4,548 86	
Arlington pumping station, pumping service,	7,751 98	
Chestnut Hill low-service pumping station, pumping service,	55,202 56	
Chestnut Hill high-service pumping station, pumping service,	18,037 01	
Spot Pond pumping station, pumping service,	15,197 19	
West Roxbury pumping station, pumping service,	137 25	
Hyde Park pumping station, pumping service,	7,252 33	
Bear Hill Reservoir,	27 00	
Chestnut Hill Reservoir and grounds,	9,420 83	
Fells Reservoir,	721 72	
Forbes Hill Reservoir,	1,114 61	
Mystic Lake, conduit and pumping station,	1,925 92	
Mystic Reservoir,	849 66	
<i>Amounts carried forward,</i>	\$122,186 92	\$216,682 47

MAINTENANCE AND OPERATION.	For the Year ending December 31, 1914.	
<i>Amounts brought forward,</i>	\$122,186 92	\$216,682 47
Distribution Department — <i>Con.</i>		
Waban Hill Reservoir,	286 82	
Weston Reservoir,	4,033 80	
Spot Pond,	8,413 25	
Buildings at Spot Pond,	245 43	
Pipe lines: —		
Low service,	28,155 11	
Northern high service,	5,357 68	
Northern extra high service,	261 47	
Southern high service,	5,759 18	
Southern extra high service,	376 35	
Supply pipe lines,	623 20	
Buildings at Chestnut Hill Reservoir,	2,094 67	
Chestnut Hill pipe yard,	1,595 87	
Glenwood pipe yard and buildings,	4,128 79	
Stables,	6,492 80	
Waste prevention,	27 75	
Venturi meters,	1,021 52	
Measurement of water,	1,601 97	
Arlington pumping station, buildings and grounds,	307 11	
Hyde Park pumping station, buildings and grounds,	357 52	
Fisher Hill Reservoir,	2,469 27	196,396 48
Total for maintaining and operating works,		\$413,078 95

(7) DETAILED FINANCIAL STATEMENT UNDER METROPOLITAN WATER ACT.

The Board herewith presents, in accordance with the requirements of the Metropolitan Water Act, a detailed statement of the expenditures and disbursements, receipts, assets and liabilities for the year 1914.

(a) *Expenditures and Disbursements.*

The total amount of the expenditures and disbursements on account of construction and acquisition of works for the year beginning January 1, 1914, and ending December 31, 1914, was \$177,397.02, and the total amount from the time of the organization of the Metropolitan Water Board, July 19, 1895, to December 31, 1914, has been \$42,414,140.55.

For maintenance and operation the expenditures for the year were \$413,078.95.

The salaries of the commissioners, and the other expenses of administration, have been apportioned to the construction of the

works and to the maintenance and operation of the same, and appear under each of those headings.

The following is a division of the expenditures according to their general character: —

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1914.	
CONSTRUCTION OF WORKS AND ACQUISITION BY PURCHASE OR TAKING.		
<i>Administration.</i>		
Commissioners,	\$2,708	34
Secretary and auditor,	750	00
Clerks and stenographers,	1,485	01
Stationery and printing,	237	24
Postage, express and telegrams,	29	20
Furniture and fixtures,	39	50
Telephone, lighting, heating, water and care of building,	203	00
Alterations and repairs of building,	44	
Rent and taxes, main office,	212	72
Miscellaneous expenses,	22	75
<i>Engineering.</i>	\$5,668 20	
Chief engineer,	\$570	52
Principal assistant engineers,	2,316	35
Engineering assistants,	7,533	82
Inspectors,	1,821	75
Railroad and street car travel,	107	97
Stationery and printing,	312	96
Engineering and drafting supplies,	47	21
Postage, express and telegrams,	2	27
Telephone, lighting, heating, water and care of buildings: —		
Main office,	609	12
Sub-offices,	2	45
Alterations and repairs of building — main office,	1	30
Rent and taxes, main office,	638	10
Unclassified supplies,	16	65
Miscellaneous expenses,	126	35
<i>Construction.</i>	14,106 82	
Preliminary work: —		
Advertising,	\$297	51
Lumber and field buildings,	10	28
Tools, machinery, appliances and hardware supplies,	1	55
309 34		
Contracts, Wachusett Reservoir: —		
McBride & Co., Stillwater Improvement, Contract 283,	\$1,314	91
Contracts, Distribution System: —		
Coffin Valve Co., for furnishing water valves, Contract 358,	2,873	00
DeVincenzi & Baruffoldi, laying water pipes in Arlington, Mass., Section 36 of Distribution System, Contract 322,	100	00
Laidlaw & Dunn-Gordon Co., for furnishing two pumping engines for Hyde Park pumping station, Contract 346,	1,725	50
<i>Amounts carried forward,</i>	\$6,013	41 \$20,084 36

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1914.	
<i>Amounts brought forward,</i>	\$6,013 41	\$20,084 36
<i>Construction — Con.</i>		
<i>Contracts, Distribution System — Con.</i>		
Roberts Iron Works, for furnishing steel casings for shafts of tunnel under Chelsea Creek, Contract 353,	1,282 00	
United States Cast Iron Pipe and Foundry Co., cast-iron water pipes and special castings, Contract 352,	8,447 14	
Warren Foundry and Machine Co., cast-iron water pipes and special castings, Contract 355,	23,481 34	
Warren Foundry and Machine Co., cast-iron water pipes and special castings, Contract 356,	23,540 00	
Coleman Bros., lowering pipe at Chelsea Creek, Contract 354,	46,757 90	
John J. Evans, for laying water pipe in Boston, Milton and Quincy, Section 43, of southern high service, Contract 359,	10,804 69	
Chas. R. Gow Co., for laying water pipe in Boston, Section 42, of southern extra high service, Contract 360,	5,863 55	
John E. Palmer, for constructing foundation for reservoir on Bellevue Hill in Boston, Contract 361,	5,424 94	
Walsh's Holyoke Steam Boiler Works, for building steel tank or reservoir on Bellevue Hill in Boston, Contract 357,	13,900 00	
		145,494 97
<i>Additional work: —</i>		
Labor,	\$3,970 21	
Traveling,	90	
Rent,	555 00	
Freight and express,	195 04	
Tools, machinery, appliances and hardware supplies,	660 55	
Castings, ironwork and metals,	616 84	
Iron pipe and valves,	1,236 62	
Paint and coating,	12 08	
Lumber and field buildings,	499 76	
Brick, cement and stone,	563 75	
Sand, gravel and filling,	148 85	
Municipal and corporation work,	3,197 76	
Unclassified supplies,	7 18	
Miscellaneous expenses,	5 85	
		11,870 39
<i>Real Estate.</i>		
<i>Legal and expert: —</i>		
Conveyancing expenses,	\$26 80	
Conveyancing supplies,	8 50	
Settlements made by Board,	75 00	
		110 30
<i>Purchase of Existing Water Works.</i>		
Legal services,		37 00
		\$177,397 02
Amount charged from beginning of work to January 1, 1914,		42,236,743 53
Total amount of construction expenditures to January 1, 1915,		\$42,414,140 55

GENERAL CHARACTER OF EXPENDITURES.		For the Year ending December 31, 1914.
MAINTENANCE AND OPERATION OF WORKS.		
Administration: —		
Commissioners,		\$5,458 33
Secretary and assistants,		4,611 61
Rent,		534 78
Repairs of building,		10 99
Fuel,		59 10
Lighting,		73 20
Care of building,		382 77
Postage,		170 00
Printing, stationery and office supplies,		1,276 04
Telephones,		105 70
Traveling expenses,		256 09
Miscellaneous expenses,		191 14
		\$13,129 75
General supervision: —		
Chief engineer and assistants,		\$22,808 24
Rent,		1,604 38
Repairs of building,		336 15
Fuel,		177 31
Lighting,		219 60
Care of building,		1,148 38
Postage,		71 00
Printing, stationery and office supplies,		557 81
Telephones,		392 27
Traveling expenses,		727 86
Miscellaneous expenses,		766 64
		28,809 64
Pumping service: —		
Labor,		\$66,154 04
Fuel,		29,456 38
Oil, waste and packing,		1,230 08
Repairs,		5,631 77
Small supplies,		1,101 05
Rent,		5 00
		103,578 32
Reservoirs, aqueducts, pipe lines, buildings and grounds: —		
Superintendents,		\$7,195 77
Engineering assistants,		10,221 04
Sanitary inspectors,		4,267 58
Labor, pay roll,		158,456 36
Labor, miscellaneous,		3,386 33
Alterations and repairs of pumping stations,		648 30
Alterations and repairs of other buildings and structures,		1,047 62
Automobiles,		4,239 68
Brick,		704 93
Amounts carried forward,	\$190,167 61	\$145,517 71

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1914.	
<i>Amounts brought forward,</i>	\$190,167 61	\$145,517 71
Reservoirs, aqueducts, pipe lines, buildings and grounds — <i>Con.</i>		
Brooms, brushes and janitor's supplies,	126 34	
Castings, ironwork and metals,	863 52	
Cement and lime,	564 23	
Drafting and photo supplies,	108 10	
Fertilizer and planting material,	1,260 77	
Freight and express,	418 28	
Fuel,	2,317 42	
Gypsy moth supplies,	1,478 49	
Hardware,	1,067 09	
Hay and grain,	1,558 72	
Lighting,	241 64	
Lumber,	1,283 46	
Machinery,	943 37	
Paints and oils,	1,017 87	
Pipe and fittings,	3,961 59	
Postage,	103 35	
Printing, stationery and office supplies,	810 37	
Rubber and oiled goods,	261 69	
Stable expenses,	718 46	
Sand, gravel and stone,	1,211 84	
Traveling expenses,	2,586 48	
Telephones,	965 89	
Teaming,	1,625 21	
Tools and appliances,	1,857 97	
Vehicles, harnesses and fittings,	493 68	
Miscellaneous expenses,	3,980 72	
Contracts: —		
C. W. Dolloff & Co., for repaving 24-inch water-pipe trench in Chelsea,		
Contract 38M,	1,319 68	
Payments in lieu of taxes,		223,313 84
		44,247 40
Total expenditures for maintenance and operation,		\$413,078 95

(b) Receipts.

The total amount of receipts from the operations of the Board and from sales of property for the year beginning January 1, 1914, and ending December 31, 1914, was \$68,889.61 and the total amount from the time of the organization of the Metropolitan Water Board, July 19, 1895, to December 31, 1914, has been \$1,010,621.30. The general character of these receipts is as follows: —

GENERAL CHARACTER OF RECEIPTS.	For the Year ending December 31, 1914.
Applicable to the loan fund: —	
Land and buildings,	\$4,608 22
Construction tools, supplies and reimbursements,	4,141 04
	\$8,749 26
Applicable to payment of interest, sinking fund requirements and expenses of maintenance and operation: —	
Proceeds from operations of the Board: —	
Rents,	\$1,834 00
Land products,	9,140 29
Electric energy,	39,892 11
Maintenance labor, tools, supplies and reimbursements,	3,711 86
Interest and unclassified receipts,	135 59
	54,713 85
Applicable to the sinking fund: —	
Water supplied to cities and towns, water companies and others,	5,426 50
	\$68,889 61
Amount credited from beginning of work to January 1, 1914,	941,731 69
Total receipts to January 1, 1915,	\$1,010,621 30

The foregoing receipts have been credited to the various objects or works, as follows: —

SOURCES OF RECEIPTS.	For the Year ending December 31, 1914.
Supplying water outside of Water District,	\$5,426 50
Construction and acquisition of works: —	
Administration,	\$25 23
Wachusett Dam,	125 34
Wachusett Reservoir,	129 64
Wachusett Aqueduct,	1 00
Distribution system,	3,999 16
Purchase of existing water works,	4,493 22
	8,773 59
Maintenance and operation of works: —	
Administration,	\$124 49
General supervision,	57 81
Wachusett Aqueduct,	274 28
Wachusett Reservoir,	8,319 06
Electric power plant,	39,921 61
Sudbury system,	2,997 92
Distribution system,	2,728 30
Clinton sewerage system,	266 05
	54,669 52
	\$68,889 61
Amount credited from beginning of work to January 1, 1914,	941,731 69
Total receipts to January 1, 1915,	\$1,010,621 30

(c) *Assets.*

The following is an abstract of the assets of the Water Works, a complete schedule of which is kept on file in the office of the Board:—

Office furniture, fixtures and supplies; engineering and scientific instruments and supplies; police supplies; horses, vehicles, field machinery, etc.; machinery, tools and other appliances and supplies; completed works, real estate and buildings connected therewith.

(d) *Liabilities.*

The sums due on monthly pay rolls amount to \$552.39 and there are bills for current expenses which have not yet been received.

Amounts on Monthly Estimates, not due until Completion of Contracts or until Claims are settled.

NAME.	Work.	Amount.
Camoia & Williams,	Contract 308, Section 33 of northern high-service pipe lines, Distribution System.	\$200 00
Joseph Hanreddy,	Contract 314, Section 7 of the Weston Aqueduct Supply Mains.	10 00
Coleman Bros.,	Contract 354, water pipe tunnel under Chelsea Creek between East Boston and Chelsea, Mass.	8,251 40
John J. Evans,	Contract 359, Section 43 of the southern high-service pipe lines, Distribution System.	1,465 53
Charles R. Gow Co.,	Contract 360, Section 42 of the southern extra high-service pipe lines, Distribution System.	1,034 74
John E. Palmer,	Contract 361, constructing foundation for reservoir on Bellevue Hill in West Roxbury District in Boston.	957 34
Walsh's Holyoke Steam Boiler Works,	Contract 357, for building steel tank or reservoir on Bellevue Hill in West Roxbury District in Boston.	1,600 00

Claims have been made by the following parties for land taken and other damages, and suits are now pending in court for the determination of many of them:—

Patrick Bradley, Henry F. Keyes, James E. Welch, Byron D. Allen, J. Frank Wood *et al.*, Edward F. Merriam, Sanford C. Kendall, estate of William H. Vickery, James H. and Hannah S. Wood, Francis W. M. Goodale, John Ward *et al.*, heirs of George K. Ward.

VI. METROPOLITAN SEWERAGE WORKS.

The North Metropolitan Sewerage District embraces the cities of Cambridge, Chelsea, Everett, Malden, Medford, Melrose, Somerville and Woburn, and the towns of Arlington, Belmont, Revere, Stoneham, Wakefield, Winchester, and Winthrop and parts of the city of Boston and the town of Lexington, — comprising in all 9

cities and 8 towns, with an area of 90.50 square miles. The district has an estimated population, based upon the United States Census of 1910, as of December 31, 1914, of 582,930. Of the total population it is estimated that 89.9 per cent., or 524,330 people, contribute sewage to the North Metropolitan System.

The South Metropolitan Sewerage District includes the cities of Newton, Quincy and Waltham, and the towns of Brookline, Milton and Watertown, and parts of the city of Boston and the town of Dedham, — a total of 4 cities and 4 towns. This district has an area of 100.87 square miles, with an estimated population as of December 31, 1914, of 405,240. According to the estimates made 67.9 per cent. of this population, or 275,310, contribute sewage to the South Metropolitan System.

(1) NORTH METROPOLITAN SEWERAGE SYSTEM — CONSTRUCTION.

The amount expended for construction on account of the North Metropolitan System during the past year was \$127,765.52.

The construction of the New Mystic sewer, authorized by the Legislature of 1912, has been completed.

The construction of the new screen-house at the East Boston pumping station, which replaces the only recently completed screen-house which was destroyed by an explosion on June 1, 1914, has been completed with the exception of a few details which do not interfere with the successful operation of the station, and arrangements are now being made which the Board believes will make a recurrence of the unfortunate accident on June 1 improbable in the future.

A branch Metropolitan sewer to receive sewage from the southwest part of the town of Revere has been constructed in accordance with the provisions of chapter 259 of the Acts of 1914. This act provides that the cost of construction of this branch sewer shall be assessed upon the town of Revere.

The Board acquired by taking easements in 0.4375 of an acre of land in Revere and Chelsea for the construction of the branch sewer for the town of Revere.

The Board has not yet begun the construction of the extension of the Deer Island outfall for which provision was made in chapter 344 of the Acts of 1914, but hopes to be able to make the necessary arrangements with the United States Government and the Directors of the Port of Boston to begin the work during the present year.

(2) NORTH METROPOLITAN SEWERAGE SYSTEM — MAINTENANCE.

The cost of the maintenance and operation of the North Metropolitan System during the past year was \$183,718.19.

Sewers and Pumping Stations.

The Metropolitan sewers in the North Metropolitan System now extend a distance of 63.66 miles, and the local sewers which are connected with the Metropolitan sewers have a further length of 728.73 miles, involving 78,417 connections.

The sewage of the North Metropolitan District flows at first by gravity, but before being finally disposed of is lifted at different points by pumping and is finally discharged into the harbor from an outfall off Deer Island.

The daily average amount of sewage discharged into the harbor was 58,700,000 gallons, a daily average for each person contributing sewage of 112 gallons. The increase in the total amount of sewage discharged was 2,100,000 gallons per day more than the discharge of the preceding year. The maximum rate of discharge in any one day was 149,700,000 gallons.

The pumping stations operated for the North Metropolitan Sewerage System are as follows:—

	Number of Engines.	Contract Capacity per Day (Gallons).	Lift (Feet).
Deer Island station (Boston harbor),	4	235,000,000	19
East Boston station,	4	235,000,000	19
Charlestown station,	3	104,000,000	{ 11 8
Alewife Brook station (Somerville),	3	22,000,000	13

There were purchased for the operation of the pumping stations 6,867.312 tons of bituminous coal, the average prices of which, at the different stations, varied from \$4.15 to \$4.97 per gross ton delivered in the bins.

The cost of operating the stations was \$107,828.21. The average cost per million gallons of sewage lifted per foot at the several stations, was \$0.146, a decrease of about 0.7 per cent. from the cost last year.

(3) SOUTH METROPOLITAN SEWERAGE SYSTEM — CONSTRUCTION.

The amount expended for construction on account of the South Metropolitan System during the past year was \$33,049.12.

Under the provisions of chapter 343 of the Acts of 1914 it is provided that the town of Wellesley may be added to the South Metropolitan Sewerage District, dependent upon the acceptance of the act by the town. No action has yet been taken by the town.

At the time of the construction of the High-level sewer two only of the 60-inch cast-iron outfall pipes, of the proposed five lines, were constructed. While these are sufficient for any ordinary discharge of sewage they have been so far overtaxed by the storm flows that it became apparent that an additional outfall capacity must be provided at this point. Accordingly a contract was made for the laying of an additional line of 60-inch cast-iron pipe to extend about 1,200 feet into tide water to a point where the channel has a depth of 20 feet at low water. Work was begun upon this contract during the past season, but on account of the exposed situation at which the work was being done it was impossible to complete it, but it is expected that the work will be completed during the early months of the present year.

(4) SOUTH METROPOLITAN SEWERAGE SYSTEM — MAINTENANCE.

The entire cost of maintenance of the South Metropolitan System during the past year was \$106,628.07.

Sewers and Pumping Stations.

The Metropolitan sewers in the South Metropolitan System, which comprise the old Charles River valley sewer and Neponset River valley sewer, as well as the new High-level sewer and extensions, have a total length of 43.48 miles, and with these are connected local sewers having a length of 610.03 miles, involving 39,764 connections.

The pumping stations operated for the South Metropolitan Sewerage System are as follows: —

	Number of Engines.	Contract Capacity per Day (Gallons).	Lift (Feet).
Ward Street station (Roxbury District),	2	100,000,000	45
Quincy station,	3	18,000,000	28
Quincy sewerage lifting station,	2	3,000,000	20

The sewage of two small districts in Dorchester and Milton, included in the Neponset River valley system, which are too low for sewage to be delivered into the High-level sewer by gravity, is, under an arrangement with the city of Boston, disposed of through the Boston Main Drainage Works at Moon Island. By this arrangement the Board is relieved from the expense of providing extra pumping facilities.

A large part of the sewage of the District is lifted into the High-level sewer at the Ward Street pumping station in Roxbury. Most of the sewage of the city of Quincy is pumped into the High-level sewer at Greenleaf Street near the Quincy pumping station. The entire sewage is screened at the Nut Island screen-house for the purpose of intercepting solid matter, and is thence discharged at the bottom of the harbor from the two outfalls about a mile off from the island.

The daily average amount of sewage thus discharged was 52,600,000 gallons, and the largest rate of discharge in a single day was during a heavy storm, when the amount reached 165,000,000 gallons. The decrease in the daily average from last year was 420,000 gallons. The daily average discharge of sewage for each individual contributing sewage in the district was 191 gallons.

There were 2,734.831 gross tons of bituminous coal purchased at the two pumping stations and screen-house, the average prices of which varied from \$4.37 to \$4.93 per gross ton delivered in the bins.

The total amount expended for the operation of the stations was \$63,284.36.

VII. SEWERAGE WORKS — FINANCIAL STATEMENT.

The financial abstract of the receipts, expenditures, disbursements, assets and liabilities of the Metropolitan Water and Sewerage Board for the fiscal year of the Commonwealth ending with November

30, 1914 was, as stated in connection with the Water Works, presented to the General Court in January, in accordance with the requirements of chapter 235 of the Acts of the year 1906, and a copy of this financial abstract is in part printed as Appendix No. 5.

The following statement of its financial doings, in relation to the Metropolitan Sewerage Works, for the calendar year 1914, is herewith presented, in accordance with the provisions of the act of 1906, as a part of the annual report of the Board.

(1) METROPOLITAN SEWERAGE LOANS, RECEIPTS AND PAYMENTS.

The loans authorized for the construction of the Metropolitan Sewerage Works, the receipts which are added to the proceeds of these loans, the expenditures for construction, and the balances available on January 1, 1915, have been as follows:—

North Metropolitan System.

Loans authorized under various acts prior to 1914 for the construction of the North Metropolitan System and the various extensions, \$7,013,865 73

Loans authorized under Acts of 1914:—

Chapter 259, Revere Extension (Section 57A), 5,500 00

Chapter 344, Deer Island Outfall Extension, 125,000 00

Receipts from sales of real estate and from miscellaneous sources which are placed to the credit of the North Metropolitan System:—

For the year ending December 31, 1914, . . . \$184 20

For the period prior to January 1, 1914, . . . 85,179 32

85,363 52

\$7,229,729 25

Amount approved for payment by the Board¹ out of the Metropolitan Sewerage Loan Fund, North System:—

For the year ending December 31, 1914, . . . \$127,765 52

For the period prior to January 1, 1914, . . . 6,963,563 58

7,091,329 10

Balance, North Metropolitan System, January 1, 1915, . . \$138,400 15

¹ The word "Board" refers to the Metropolitan Sewerage Commission and the Metropolitan Water and Sewerage Board.

South Metropolitan System.

Loans authorized under the various acts, applied to the construction of the Charles River valley sewer, Neponset valley sewer, High-level sewer and extension, constituting the South Metropolitan System, \$8,867,046 27

Receipts from pumping, sales of real estate and from miscellaneous sources, which are placed to the credit of the South Metropolitan System: —

For the year ending December 31, 1914, . . . \$10 66

For the period prior to January 1, 1914, . . . 14,081 35

14,092 01

\$8,881,138 28

Amount approved by the Board for payment out of the Metropolitan Sewerage Loan Fund, South System: —

On account of the Charles River valley sewer, \$800,046 27

On account of the Neponset valley sewer, . . . 911,531 46

On account of the High-level sewer and extension: —

For the year ending December 31, 1914, . . . \$33,049 12

For the period prior to January 1, 1914, . . . 7,111,009 43

7,144,058 55

8,855,636 28

Balance, South Metropolitan System, January 1, 1915, . . \$25,502 00

(2) TOTAL SEWERAGE DEBT, DECEMBER 31, 1914.

North Metropolitan System.

Bonds issued by the Treasurer of the Commonwealth: —

Sinking fund bonds (3 and 3½ per cent.), . . . \$6,563,000 00

Serial bonds (3½ and 4 per cent.), . . . 440,000 00

Total bond issue (North System) to December 31, 1914, . . \$7,003,000 00

Serial bonds paid prior to January 1, 1914, . . . \$3,000 00

Serial bonds paid in 1914, . . . 13,000 00

16,000 00

Total bond issue (North System) outstanding December

31, 1914, \$6,987,000 00

Gross Sewerage Debt (North System), \$6,987,000 00

Sinking fund (North System) December 31, 1914, . . . 1,922,492 30

Net Sewerage Debt (North System) December 31, 1914, . . \$5,064,507 70

A decrease for the year of \$178,782.83.

South Metropolitan System.

Bonds issued by the Treasurer of the Commonwealth:—

Sinking fund bonds (3 and 3½ per cent.),	\$8,877,912 00
Serial bonds,	—

Total bond issue (South System), to December 31, 1914, . \$8,877,912 00

Gross Sewerage Debt (South System), \$8,877,912 00

Sinking fund (South System) December 31, 1914, 1,089,020 14

Net Sewerage Debt (South System) December 31, 1914, . . \$7,788,891 86

A decrease for the year of \$96,391.71.

(3) NORTH AND SOUTH METROPOLITAN LOAN AND SINKING FUNDS,
DECEMBER 31, 1914.

YEAR.	LOANS.		BONDS ISSUED (SINKING FUND).		BONDS ISSUED (SERIAL BONDS).	SINKING FUND.
	North System.	South System.	North System.	South System.	North System.	North and South Systems.
1889.	\$5,000,000 00	—	—	—	—	—
1890.	—	—	\$2,200,000	\$800,000	—	—
1891.	—	—	368,000	—	—	—
1892.	—	—	1,053,000	—	—	—
1893.	—	—	579,000	—	—	—
1894.	500,000 00	—	500,000	—	—	—
1895.	300,000 00	\$500,000 00	300,000	300,000	—	—
1896.	30,000 00	—	30,000	200,000	—	—
1897.	85,000 00	300,000 00	80,000	300,000	—	—
1898.	215,000 00	35,000 00	220,000	35,000	—	—
1899.	—	4,825,000 00	—	1,025,000	—	\$361,416 59
1900.	265,000 00	10,912 00 ¹	265,000	10,912	—	454,520 57
1901.	—	40,000 00	—	2,040,000	—	545,668 26
1902.	—	—	—	864,000	—	636,084 04
1903.	500,000 00	1,000,000 00	500,000	1,736,000	—	754,690 41
1904.	—	392,000 00	—	392,000	—	878,557 12
1905.	—	—	—	—	—	1,008,724 95
1906.	55,000 00	1,175,000 00	55,000	175,000	—	1,146,998 68
1907.	—	—	—	300,000	—	1,306,850 30
1908.	413,000 00	—	—	700,000	—	1,492,418 98
1909.	—	—	300,000	—	—	1,673,784 40
1910.	56,000 00	—	113,000	—	—	1,931,741 89
1911.	6,000 00	—	—	—	—	2,184,674 98
1912.	378,000 00	—	—	—	\$62,000	2,458,541 20
1913.	—	—	—	—	378,000	2,749,337 90
1914.	130,500 00	—	—	—	—	3,011,512 44
	\$7,933,500 00 ²	\$8,077,912 00	—	—	—	—
	789,134 27	789,134 27	—	—	—	—
	\$7,144,365 73	\$8,867,046 27	\$6,563,000	\$8,877,912	\$440,000	—

¹ The sum of \$10,912 was appropriated to reimburse the town of Watertown for the expense of constructing the Watertown siphon.² Of this amount \$789,134.27 was expended for the construction of the Charles River valley sewer, which is now included in the South Metropolitan System.

(4) ANNUAL APPROPRIATIONS, RECEIPTS AND EXPENDITURES.

The annual appropriations for the maintenance of the Metropolitan Sewerage Works, the receipts of the Board which are added to the appropriations for maintenance, and the expenditures for maintenance for the year ending December 31, 1914, were as follows:—

North Metropolitan System.

Appropriations as follows:—

Chapter 220, Acts of 1914,	\$173,000 00
Chapter 645, Acts of 1914,	175 00
Chapter 734, Acts of 1914,	1,500 00
Chapter 775, Acts of 1914,	35,000 00
Chapter 796, Acts of 1914,	200 00
Receipts from pumping and from other sources,	356 39
	<hr/>
	\$210,231 39
Amount approved by the Board for payment,	183,718 19
	<hr/>
Balance, January 1, 1915,	\$26,513 20

South Metropolitan System.

Appropriations as follows:—

Chapter 221, Acts of 1914,	\$112,570 00
Chapter 734, Acts of 1914,	1,500 00
Receipts from pumping and from other sources,	172 46
	<hr/>
	\$114,242 46
Amount approved by the Board for payment,	106,628 07
	<hr/>
Balance, January 1, 1915,	\$7,614 39

(5) SEWER ASSESSMENTS, 1914.

The following sewer assessments were made by the Treasurer of the Commonwealth upon the various municipalities:—

North Metropolitan Sewerage System.

Sinking fund requirements,	\$95,094 00
Serial bonds,	10,000 00
Interest,	214,302 22
Maintenance:—	
Appropriated by Legislature,	\$209,875 00
Less balance on hand,	200 01
	<hr/>
	209,674 99
Total North Metropolitan sewerage assessment,	\$529,071 21

South Metropolitan Sewerage System.

Sinking fund requirements,	\$56,506 00
Interest,	303,386 86
Maintenance: —	
Appropriated by Legislature,	\$114,070 00
Less balance on hand,	8,111 65
	<hr/> 105,958 35

Total South Metropolitan sewerage assessment, \$465,851 21

In accordance with the provisions of chapter 369, Acts of 1906, the proportion to be paid by each city and town to meet the interest and sinking fund requirements for each year is based upon their respective taxable valuations, and to meet the cost of maintenance and operation upon their respective populations.

The divisions of the assessments for 1914 were as follows: —

North Metropolitan Sewerage System.

CITIES AND TOWNS.	Assessment.	CITIES AND TOWNS.	Assessment.
Arlington,	\$14,611 90	Melrose,	\$17,437 18
Belmont,	8,227 20	Revere,	18,890 77
Boston,	89,150 10	Somerville,	72,437 60
Cambridge,	114,341 14	Stoneham,	5,960 69
Chelsea,	29,704 27	Wakefield,	11,118 54
Everett,	31,656 73	Winchester,	13,793 19
Lexington,	4,819 43	Winthrop,	13,841 23
Malden,	43,619 59	Woburn,	13,425 71
Medford,	26,035 94	Total,	\$529,071 21

South Metropolitan Sewerage System.

CITIES AND TOWNS.	Assessment.	CITIES AND TOWNS.	Assessment.
Boston,	\$215,221 80	Quincy,	\$29,125 39
Brookline,	90,022 00	Waltham,	25,622 38
Dedham,	10,700 14	Watertown,	14,490 71
Milton,	21,515 56	Total,	\$465,851 21
Newton,	59,153 23		

(6) EXPENDITURES FOR THE DIFFERENT WORKS.

The following is a summary of the expenditures made in the various operations for the different works: —

CONSTRUCTION AND ACQUISITION OF WORKS.	For the Year ending December 31, 1914.
<i>North Metropolitan System.</i>	
North System, main line and branches,	\$17 84
North System, enlargement: —	
Administration,	\$5,172 11
East Boston pumping station, extensions and additions,	273 30
New Mystic sewer,	117,452 99
Relocation part of Section 30, Cambridge,	408 13
Section 48A, Somerville and Medford,	286 62
Section 57A, Revere Extension,	3,724 28
Deer Island Outfall Extension,	430 25
	127,747 68
Amount charged from beginning of work to January 1, 1914,	6,963,563 58
Total for North Metropolitan System to January 1, 1915,	\$7,091,329 10
<i>South Metropolitan System.</i>	
High-level sewer,	\$529 17
High-level sewer extension: —	
Administration,	\$710 87
Section 85, Brighton,	28 86
Relief Outfall, Section 43,	31,780 22
	32,519 95
	\$33,049 12
Amount charged from beginning of work to January 1, 1914,	8,822,587 16
Total for South Metropolitan System to January 1, 1915,	\$8,855,636 28
Total for construction, both systems,	\$15,946,965 38

MAINTENANCE AND OPERATION.	For the Year ending December 31, 1914.
North Metropolitan System,	\$183,718 19
South Metropolitan System,	106,628 07
Total for maintenance, both systems,	\$290,346 26

(7) DETAILED FINANCIAL STATEMENT.

The Board herewith presents, in accordance with the Metropolitan Sewerage acts, an abstract of the expenditures and disbursements, receipts, assets and liabilities for the year ending December 31, 1914: —

(a) *Expenditures and Disbursements.*

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1914.	
CONSTRUCTION OF WORKS AND ACQUISITION BY PURCHASE OR TAKING.		
<i>North Metropolitan System.</i>		
Original system, main line and branches: —		
Land takings, purchase and recording,		\$17 84
<i>North System Enlargement.</i>		
Administration: —		
Commissioners,	\$2,333 33	
Secretary,	375 00	
Clerks and stenographers,	1,662 16	
Stationery, printing and office supplies,	350 41	
Telephone, lighting, heating, water and care of building,	234 57	
Repairs of building,	1 03	
Rent and taxes, main office,	215 61	
		5,172 11
Engineering: —		
Chief engineer,	\$965 29	
Engineering assistants,	5,477 33	
Inspectors,	2,786 95	
Traveling expenses,	312 15	
Stationery, printing and office supplies,	50 76	
Engineering and drafting instruments and tools,	1 00	
Engineering and drafting supplies,	12 56	
Telephone, lighting, heating, water and care of building,	703 75	
Repairs of building,	3 07	
Rent and taxes,	646 88	
Miscellaneous expenses,	435 10	
		11,394 84
Advertising,	\$72 73	
Labor and teaming,	822 87	
Tools, machinery and appliances,	1 60	
Brick, cement, lumber and other field supplies and expenses,	2,775 93	
		3,673 13
Contracts: —		
William J. Barry, Contract 102 for building relocation of part of Section 30, Cambridge,	\$408 13	
Ross & Barbaro, Contract 103, for constructing Section 70 (New Mystic sewer) in Winchester,	9,636 55	
G. M. Bryne Co., Contract 104, for constructing Section 68 (New Mystic sewer) in Winchester,	10,663 49	
Amounts carried forward,	\$20,708 17	\$20,257 92

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1913.	
<i>Amounts brought forward,</i>	\$20,708 17	\$20,257 92
<i>North System Enlargement — Con.</i>		
Contracts — <i>Con.</i>		
Antony Cefalo, Contract 105, for constructing Section 48A in Somerville and Medford,	246 62	
G. M. Bryne Co., Contract 112, for constructing Section 57A of the Revere Extension in Chelsea and Revere,	3,005 45	
Henry Spinach Contracting Co., Contract 110, for constructing part of Section 60 (New Mystic sewer) in Winchester,	32,175 21	
Henry Spinach Contracting Co., Contract 111, for constructing part of Section 60 (New Mystic sewer) in Winchester,	46,018 97	
		102,154 42
Real estate: —		
Legal, conveyancing and expert,	\$256 93	
Settlements,	5,096 25	
		5,353 18
Total for North Metropolitan System,		\$127,765 52
<i>South Metropolitan System.</i>		
<i>High-level Sewer.</i>		
Engineering: —		
Engineers, inspectors, rodmen, laborers and others,	\$524 17	
Land takings, purchase and recording,	5 00	
		\$529 17
<i>High-level Sewer Extension.</i>		
Administration: —		
Secretary,	\$375 00	
Clerks and stenographers,	226 67	
Stationery, printing and office supplies,	39 08	
Telephone, lighting, heating, water and care of building,	39 11	
Rent and taxes, main office,	28 74	
Miscellaneous expenses,	2 27	
		710 87
Engineering: —		
Chief engineer,	\$520 84	
Engineering assistants,	1,476 58	
Inspectors,	168 00	
Traveling expenses,	51 10	
Stationery, printing and office supplies,	84 38	
Telephone, lighting, heating, water and care of building,	112 68	
Rent and taxes, main office,	86 25	
		2,499 83
Advertising,	\$71 13	
Labor and teaming,	950 67	
Tools, machinery and appliances,	835 00	
Brick, cement, lumber and other field supplies and expenses,	338 49	
		2,195 29
<i>Amount carried forward,</i>		\$5,935 16

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1914.
<i>Amount brought forward,</i>	\$5,935 16
<i>South Metropolitan System — Con.</i>	
<i>High-level Sewer Extension — Con.</i>	
Contracts:—	
Camden Iron Works, Contract 113, for furnishing cast-iron pipes and special castings,	\$17,799 90
W. H. Ellis & Son Co., Contract 120, for constructing part of Section 43, Relief Outfall line of the High-level sewer in Boston Harbor,	9,314 06
	27,113 96
<i>Total for South Metropolitan System,</i>	<u>\$33,049 12</u>
MAINTENANCE AND OPERATION OF WORKS.	
<i>North Metropolitan System.</i>	
Administration:—	
Commissioners,	\$1,125 00
Secretary and assistants,	3,550 16
Rent,	230 00
Heating, lighting and care of building,	198 68
Repairs of building,	9 93
Postage,	61 20
Printing, stationery and office supplies,	547 01
Telephones,	36 04
Traveling expenses,	3 44
Miscellaneous expenses,	43 14
	\$5,804 60
General supervision:—	
Chief engineer and assistants,	\$6,172 29
Rent,	690 00
Heating, lighting and care of building,	596 20
Repairs of building,	29 83
Printing, stationery and office supplies,	132 27
Telephones,	108 16
Traveling expenses,	51 77
Miscellaneous expenses,	7 00
	7,787 52
Deer Island pumping station:—	
Labor,	\$18,944 81
Fuel,	9,485 47
Oil and waste,	66 91
Water,	1,536 00
Packing,	188 29
Repairs and renewals,	1,157 57
Telephones,	17 10
General supplies,	514 62
Miscellaneous supplies and expenses,	683 23
	32,594 00
<i>Amount carried forward,</i>	<u>\$46,186 12</u>

GENERAL CHARACTER OF EXPENDITURES.		For the Year ending December 31, 1914.	
Amount brought forward,			\$46,186 12
North Metropolitan System — Con.			
East Boston pumping station: —			
Labor,	\$22,808 87		
Fuel,	11,549 61		
Oil and waste,	543 17		
Water,	2,347 20		
Packing,	70 00		
Repairs and renewals,	1,317 41		
Telephones,	9 48		
General supplies,	542 98		
Miscellaneous supplies and expenses,	729 24		
			39,917 96
Charlestown pumping station: —			
Labor,	\$17,252 53		
Fuel,	4,434 15		
Oil and waste,	224 19		
Water,	764 40		
Packing,	64 92		
Repairs and renewals,	571 20		
Telephones,	51 46		
General supplies,	417 31		
Miscellaneous supplies and expenses,	311 98		
			24,092 14
Alewife Brook pumping station: —			
Labor,	\$8,605 95		
Fuel,	1,843 59		
Oil and waste,	224 52		
Water,	209 16		
Packing,	30 31		
Repairs and renewals,	106 47		
Telephones,	40 88		
General supplies,	64 92		
Miscellaneous supplies and expenses,	98 31		
			11,224 11
Sewer lines, buildings and grounds: —			
Engineering assistants,	\$3,710 04		
Labor,	30,611 32		
Automobiles,	184 73		
Brick, cement and lime,	718 80		
Castings, ironwork and metals,	683 33		
Freight, express and teaming,	46		
Fuel and lighting,	29 00		
Jobbing and repairing,	105 25		
Lumber,	920 07		
Machinery, tools and appliances,	336 26		
Paint and oils,	346 26		
Rubber and oiled goods,	342 67		
Amounts carried forward,	\$37,968 19	\$121,420 33	

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1914.	
<i>Amounts brought forward,</i>	\$37,988 19	\$121,420 33
<i>North Metropolitan System — Con.</i>		
Sewer lines, buildings and grounds — <i>Con.</i>		
Sand, gravel and stone,	153 96	
Telephones,	20 95	
Traveling expenses,	313, 11	
General supplies,	793 42	
Miscellaneous expenses,	447 86	
		39,717 49
Horses, vehicles and stable account,		4,186 46
Restoration East Boston screen-house (chapter 775, Acts of 1914): —		
Engineering,	\$908 43	
Labor,	5,039 25	
Tools, machinery and appliances,	367 81	
Brick, cement and other supplies and expenses,	1,502 75	
		7,718 24
Contracts: —		
S. H. Pomeroy Co., Inc., Contract 118, for doors, windows and monitors,	\$3,675 00	
J. Caddigan Co., Contract 121, for building new screen-house at East Boston pumping station,	4,250 00	
E. VanNoorden & Co., Contract 119, for repairing and furnishing sky-lights at East Boston pumping station and locker building,	695 00	
		8,620 00
Payments under Industrial Accident Law and Special Benefit Appropriations,		2,055 67
Total for North Metropolitan System,		\$183,718 19
<i>South Metropolitan System.</i>		
Administration: —		
Commissioners,	\$2,333 34	
Secretary and assistants,	2,067 34	
Rent,	215 62	
Heating, lighting and care of building,	203 83	
Repairs of building,	4 41	
Postage,	51 00	
Printing, stationery and office supplies,	448 53	
Telephones,	30 97	
Traveling expenses,	18 00	
Miscellaneous expenses,	17 03	
		\$5,390 07
General supervision: —		
Chief engineer and assistants,	\$2,838 53	
Rent,	646 88	
Heating, lighting and care of buildings,	611 58	
Repairs of building,	13 24	
Postage,	16 00	
Printing, stationery and office supplies,	209 92	
<i>Amounts carried forward,</i>	\$4,336 15	\$5,390 07

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1914.	
<i>Amounts brought forward,</i>	\$4,336 15	\$5,390 07
<i>South Metropolitan System — Con.</i>		
General supervision — <i>Con.</i>		
Telephones,	92 93	
Traveling expenses,	25 00	
Miscellaneous expenses,	6 50	
Ward Street pumping station: —		
Labor,	\$23,499 82	
Fuel,	10,522 87	
Oil and waste,	230 47	
Water,	1,528 80	
Packing,	268 43	
Repairs and renewals,	2,496 83	
Telephones,	49 13	
General supplies,	1,250 52	
Miscellaneous supplies and expenses,	268 99	
Quincy pumping station: —		
Labor,	\$8,178 92	
Fuel,	2,040 65	
Oil and waste,	64 27	
Water,	212 23	
Packing,	29 74	
Repairs and renewals,	249 75	
Telephones,	35 28	
General supplies,	343 42	
Miscellaneous supplies and expenses,	37 75	
Nut Island screen-house: —		
Labor,	\$8,260 93	
Fuel,	2,496 12	
Oil and waste,	131 08	
Water,	318 95	
Packing,	19 93	
Repairs and renewals,	44 20	
Telephones,	46 18	
General supplies,	493 83	
Miscellaneous supplies and expenses,	165 27	
Sewer lines, buildings and grounds: —		
Engineering assistants,	\$4,050 46	
Labor,	17,311 16	
Automobiles,	204 34	
Brick, cement and lime,	246 18	
Castings, ironwork and metals,	139 86	
Fuel and lighting,	71 25	
Jobbing and repairing,	17 25	
<i>Amounts carried forward,</i>	\$22,040 80	\$73,135 01

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1914.	
<i>Amounts brought forward,</i>	\$22,040 50	\$73,135 01
<i>South Metropolitan System — Con.</i>		
Sewer lines, buildings and grounds — <i>Con.</i>		
Lumber,	297 36	
Machinery, tools and appliances,	528 96	
Paints and oils,	137 43	
Rubber and oiled goods,	123 28	
Sand, gravel and stone,	164 25	
Telephones,	33 40	
Traveling expenses,	546 11	
General supplies,	251 71	
Miscellaneous expenses,	150 61	
		24,273 61
City of Boston, for pumping and interest,		6,423 73
Horses, vehicles and stable account,		2,795 72
Total for South Metropolitan System,		\$106,628 07

(b) *Receipts.*

The receipts from the sales of property, from rents and from other sources, have been credited as follows: —

ACCOUNT.	For the Year ending December 31, 1914.	
Construction: —		
North Metropolitan System,	\$184 20	
South Metropolitan System,	10 66	
Maintenance: —		
North Metropolitan System,	356 39	
South Metropolitan System,	172 46	
		\$723 71
Amount credited from beginning of work to January 1, 1914,	120,161 30	
Total receipts to January 1, 1915,		\$120,885 01

(c) *Assets.*

The following is an abstract of the assets of the Sewerage Works, a complete schedule of which is kept on file in the office of the Board: —

Office furniture, fixtures and supplies; engineering and scientific instruments and supplies; horses, vehicles, field machinery, etc.; machinery, tools and other appliances and supplies; completed works, real estate connected therewith.

(d) Liabilities.

There are bills for current expenses which have not yet been received.

Amounts on Monthly Estimates, not due until Completion of Contracts or until Claims are settled.

NAME.	Work.	Amount.
High-level Sewer: —		
National Contracting Co., . . .	Section 73, Contract abandoned, . . .	\$5,516 17 ¹
E. W. Everson & Co., . . .	Section 75, Contract 14, . . .	1,000 00
High-level Sewer Extension: —		
Timothy J. O'Connell, . . .	Section 82, in part, Contract 57, . . .	60 00
W. H. Ellis & Son Co., . . .	Section 43, in part, Relief Outfall line, Contract 120, . . .	1,643 66
North Metropolitan Construction: —		
G. M. Byrne Co., . . .	Section 57A, Revere Extension, Contract 112, . . .	158 18
Henry Spinach Contracting Co., . . .	Section 69, in part (New Mystic sewer), Contract 110, . . .	5,677 97
Henry Spinach Contracting Co., . . .	Section 69, in part (New Mystic sewer), Contract 111, . . .	8,120 98
North Metropolitan Maintenance: —		
J. Caddigan Co., . . .	New screen-house at East Boston pumping station, Contract 121, . . .	750 00

¹ Damages claimed by the Commonwealth on account of the abandonment of the contract exceed this amount.

Claims have been made by the following parties for land taken and other damages, and suits are now pending in the courts for the determination of many of them: —

Anna L. Dunican, Carrie S. Urquhart, N. Jefferson Urquhart, Edwin N. Urquhart, Richard Jones, James Doherty, Michael Niland, William H. Gibbons, Francis Normile, Boston & Maine Railroad, Elizabeth Clark, Edward F. Mills, Hermon W. Pratt.

VIII. RECOMMENDATIONS FOR LEGISLATION.

In the abstract of the annual report for the year 1914 the Board made the following statement and recommendations: —

On the first day of June, 1914, an explosion took place in the screen-house of the East Boston sewerage pumping station which completely destroyed that portion of the station and caused the death of six men and the serious injury of two others.

A careful examination of all the conditions surrounding this accident satisfied this Board that the presence of gasoline in the sewers was immediately responsible for the explosion, and it was also evident that the sewers in close connection with the pumping station on the east side of Chelsea Creek in East Boston contained

the largest quantity of this dangerous element. All the usual precautions had been taken in the presence of this ever present danger, and this Board cannot look forward to any adequate protection against its recurrence until some additional legislation gives to the Board the power to regulate the conditions under which waste matters are discharged into such local sewers as ultimately discharge into the Metropolitan sewer.

The reconstruction of the screen-house was immediately undertaken and is now approaching completion. Every effort has been made to arrange the details of operation in it so that the recurrence of such explosions may be rendered less probable.

It may be remarked in this connection that accidents of this sort have occurred in several American cities, in some instances attended with much greater destruction of property but in no case with so large a loss of human life.

In order to give the Board sufficient control over the nature of the sewage received by the Metropolitan sewers, it is respectfully suggested that a slight change be made in the language of section 9 of chapter 439 of the Acts of the year 1889 and section 8 of chapter 424 of the Acts of the year 1899, so that these sections may read: Any city or town within whose limits any main sewer shall have been constructed under the provisions of this act shall connect its local sewers with such main sewer and use the same, subject to the direction, control and regulation of said board, and any person, firm or corporation may, subject to the direction, control and regulation from time to time of said board, and subject to such terms, conditions and regulations as each city or town may prescribe, connect private drains with said main sewer.

When the explosion took place in the screen-house of the East Boston pumping station the damage to the structures underlying the pumping station was assumed by the engineers in charge of the works to be much larger than it was found to be when it was possible to make a proper examination of their condition after the removal of the ruined structure. In consequence, the appropriation of \$35,000 for this work was larger than we have found to be necessary for the reconstruction of the building, and we have a balance on hand of \$13,000 now chargeable to the maintenance account of the North Metropolitan Sewerage District. Certain changes have been made in other portions of the sewerage system of the North Metropolitan District which involve an expense greater than the amounts already appropriated, but this amount would be no greater than the \$13,000, being the unexpended balance of the \$35,000 appropriated for the repairs at East Boston. We therefore recommend that this amount be transferred from the maintenance account of the North Metropolitan District to the construction account of the North Metropolitan District.

When the work was planned for the extension of the South Metropolitan Sewer by an additional outlet at Nut Island, the Board's plan at that time contemplated simply an extension to low-water mark. The State Board of Health, under whose general control the extensions of the sewerage systems have been made into the tidal waters of Boston Harbor, insisted upon a more distant outlet, and an additional appropriation to meet the expense occasioned by this change in the Nut Island outlet will have to be made. The Board estimates the expense of such change at the sum of \$5,000.

The detailed reports of the Chief Engineer of the Water Works and of the Engineer of the Sewerage Works, with various tables and statistics, are herewith presented.

Respectfully submitted,

HENRY P. WALCOTT,
EDWARD A. McLAUGHLIN,
THOMAS E. DWYER,

Metropolitan Water and Sewerage Board.

Boston, February 19, 1915.

REPORT OF CHIEF ENGINEER OF WATER WORKS.

To the Metropolitan Water and Sewerage Board.

GENTLEMEN: — The following is a report of the work done under the direction of the Chief Engineer of the Metropolitan Water Works in connection with the construction, maintenance and operation of the works controlled by the Metropolitan Water and Sewerage Board and used for supplying water to the Metropolitan Water District.

ORGANIZATION.

The Chief Engineer has had the following assistants: —

William E. Foss,	. . . . .	Assistant to Chief Engineer.
Elliot R. B. Allardice,	. . . . .	Superintendent of Wachusett Department.
Charles E. Haberstroh,	. . . . .	Superintendent of Sudbury Department.
Samuel E. Killam,	. . . . .	Superintendent of Pipe Lines and Reservoirs, Distribution Department.
Arthur E. O'Neil,	. . . . .	Superintendent of Pumping Stations, Distribution Department.
Alfred O. Doane,	. . . . .	Division Engineer, specially in charge of engineering work at pumping stations.
Clifford Foss,	. . . . .	Assistant Engineer.
Benjamin F. Hancox,	. . . . .	Assistant in charge of Drafting Department.
James W. Killam,	. . . . .	Assistant Engineer, in charge of tests of coal and oil.
William E. Whittaker,	. . . . .	Office assistant.
Charles E. Livermore,	. . . . .	Biologist.
William W. Locke,	. . . . .	Sanitary Inspector.

These, together with other assistant engineers, instrumentmen, office assistants, stenographers, clerks and messengers, have constituted a force averaging 43 for the year.

The number of men exclusive of the engineering force above mentioned who have been employed in operating the pumping stations, in maintaining the reservoirs, aqueducts and pipe lines, and in doing minor construction work, has been as follows: —

	Beginning of Year.	End of Year.	Average.
Wachusett Department,	40	42	51
Sudbury Department,	49	55	57
Distribution Department, pipe lines and reservoirs, . .	80	82	83
Distribution Department, pumping stations,	56	57	57
	225	236	248

CONSTRUCTION.

WATER PIPE TUNNEL UNDER CHELSEA CREEK.

The Legislature of 1913 appropriated \$75,000 for the construction of a tunnel under Chelsea Creek between Chelsea and East Boston in which to place a 42-inch cast-iron water main for use in supplying water to the East Boston district. After this is done the two 24-inch pipe lines now used, which are laid a few feet below the bed of the creek, are to be removed in order that they may not interfere with the deepening of the channel by the United States Government. Preliminary borings and plans for the tunnel work were prepared in 1913. The plan received the approval of the Secretary of War on June 17, 1914. A contract for the construction of the tunnel and its approaches and for laying the pipes was made with Coleman Brothers of Chelsea on April 27, and the work will be completed early in 1915. The work embraces the construction, under pneumatic pressure, of a brick-lined tunnel 8.5 feet in exterior diameter, 640 feet long, in which is laid a 42-inch diameter cast-iron pipe with a space between the exterior of the pipe and the interior of the tunnel and shafts, filled with concrete masonry.

The axis of the horizontal portion of the tunnel is 43 feet below mean low water, and the vertical shafts, which extend 15 feet above Boston City Base, are 524 feet from centre to centre. The upper portion of each shaft is encased in sheet steel $\frac{1}{2}$ an inch in thickness for a distance of 27 feet, extending into the mud bottom of the channel. The Chelsea shaft is located 175 feet from Marginal Street. A bulkhead about 100 feet long has been built across the

end of the dock just outside of this shaft, and the property of the Board between the bulkhead and Marginal Street filled to elevation 16 along the centre of the lot, sloping to elevation 12 along the sides.

The contractor began work May 5, placed the steel casing sections of the shafts in position on June 23, and began work under compressed air at the Chelsea shaft on June 26. The construction of the tunnel and shafts was carried on continuously with a force of 45 men, working in three 8-hour shifts, until November 18, when the tunnel was completed, the air pressure was removed and the work of laying the 42-inch pipe begun. Pipe laying and the placing of concrete between the pipe and sides of the tunnel continued during December, and was finished on December 31.

The work remaining to be done consists of making connections with existing mains in Chelsea and East Boston, removing the existing pipes in the channel and completing minor details. The amount expended on account of the work to December 31, 1914, was \$55,-229.66.

ADDITIONAL 24-INCH MAIN IN MILTON AND QUINCY.

The Legislature of 1914 authorized the laying of a 24-inch pipe from the Lower Mills in Dorchester, through Adams Street in Milton and Quincy to the junction of Adams and Beale streets, a distance of 13,000 feet. The pipes have been furnished by the Warren Foundry & Machine Company of Phillipsburg, N. J., at \$20.50 per ton, and the valves by the Coffin Valve Company of Boston. A contract for laying the pipes was made on August 4 with John J. Evans of Lawrence, who began work on August 12, and at the end of the year had laid 9,850 feet of pipe, extending through Adams Street from Beale Street, in Quincy, to Hutchinson Street in Milton, the amount of work done being equivalent to 77 per cent. of the total. The greater portion of the new line was placed in service on November 8.

This pipe line is being laid to reinforce the existing single 24-inch main in case of extraordinary draft or in case of accident.

NEW HIGH-SERVICE RESERVOIR AND FORCE MAIN.

The reservoir or standpipe on Bellevue Hill in West Roxbury, which has been used in connection with the pumping station at Hyde Park in supplying water to the higher lands in West Roxbury,

Hyde Park and Milton, has a storage capacity of but 135,000 gallons. For the purpose of providing more adequate storage, the construction of a larger reservoir, with a capacity of 2,500,000 gallons, and the completion of a 20-inch pipe line between the pumping station and the reservoir, was authorized under chapter 601 of the acts of 1914. The pipes for the force main were purchased in June from the Warren Foundry & Machine Company, and a contract for laying them was made with the Charles R. Gow Company on August 7. Work was begun August 13, completed November 5, and included the laying of 4,966 feet of 20-inch pipe and 391 feet of 16, 12 and 6-inch pipe for drains and connections. The value of the work done under this contract was \$6,898.29.

A contract for making the necessary excavation for and placing the concrete in the foundation for the reservoir was made with John E. Palmer of Boston on August 4. The concrete base on which the steel tank rests is 117 feet 6 inches in diameter, 2 feet 8 inches thick for a width of 7 feet at the circumference, 3 feet thick under six columns which will support the roof, and 12 inches thick under the remainder of the tank. The earth below the concrete is a clayey, gravelly hard pan. Work under this contract, which amounted to \$6,382.28, was completed on October 7.

A contract for the steel tank for the reservoir was made with Walsh's Holyoke Steam Boiler Works, of Holyoke, on August 7 for \$19,397. The work of erecting the tank was begun on October 10 and was practically finished at the end of the year, although the tank has not yet been filled with water for test. The tank is 100 feet in diameter, with bottom composed of steel plates $\frac{3}{8}$ of an inch in thickness, 20 feet long and 8 feet wide. The sides of the tank are 44 feet 3 inches high, composed of seven courses of alternating inner and outer plates varying in thickness from $\frac{3}{8}$ to $\frac{7}{8}$ of an inch. The junction of the bottom and sides of the tank is made with a 6-inch x $3\frac{1}{2}$ -inch x $\frac{3}{4}$ -inch angle on the inside, and the top edge of the tank is stiffened with a 3-inch x $\frac{3}{8}$ -inch Z bar on the inside. The circumferential joints are double riveted and the vertical joints are butted and secured together with inside and outside straps. The tank is fitted with an overflow weir 5 feet long, set at elevation 375 above Boston City Base and 1 foot 3 inches below the top of the tank. The steel plates for the tank were furnished by the Lukens Iron & Steel Company under specifications which require a tensile

strength of between 57,000 and 62,000 pounds per square inch, and chemical requirements in accordance with the specifications of the American Society for Testing Materials. All rivet holes in plates more than $\frac{3}{8}$ of an inch thick were punched at least $\frac{3}{16}$ of an inch smaller than the finished diameter, and reamed after the plates were erected and bolted in place. The bottom of the tank and one course of the side plates were erected upon blocking and then lowered into final position by means of screw jacks placed around the outside edge and through five holes cut in the bottom plates. After this was done the space under the bottom of the tank was filled with cement grout mixed in the proportion of 1 part Portland cement, 1 part fine sand and $2\frac{1}{2}$ parts of water by volume. The grout was mixed in steel tanks, stirred with compressed air and poured through 66 1-inch diameter holes in the tank bottom, which were afterward plugged. This part of the work cost \$1,053.67, and in doing it 222 barrels of cement and 33 cubic yards of sand were used.

The completed reservoir will include a granite masonry tower surrounding and enclosing the tank. This portion of the work is to be done during the coming year.

The amount expended on account of the reservoir and force main to December 31 was \$46,320.64.

60-INCH SUPPLY MAIN FROM THE WESTON AQUEDUCT.

Under authority granted in 1909, the Board in the years 1909 and 1910 constructed 20,255 feet of this main, extending from a point on Commonwealth Avenue near Valentine Street, in Newton, to Cleveland Circle near Chestnut Hill Reservoir, and the completion of the line to the Charles River, a further distance of 14,474 feet, was at that time deferred. As it appeared to be an opportune time for the completion of the work, contracts for furnishing the pipes and special castings required were made on November 25 and 28 with the United States Cast Iron Pipe & Foundry Company, of Philadelphia, for \$19.60 per ton for the pipes and \$49 per ton for the special castings. These contracts will amount to about \$143,000. About 240 tons of the pipes had been delivered at the close of the year. Contracts for laying the pipes will be made early in the coming season.

SALE OF POWER AT THE SUDBURY DAM.

Chapter 601 of the Acts of 1914 authorized the expenditure of \$80,000 in constructing a hydro-electric plant at the Sudbury Dam, in Southborough, to be used in developing electric energy and thus conserving the power in the water used, previous to its use in the Metropolitan District.

Before installing the necessary machinery it was deemed expedient to make a contract for the sale of the energy. Bids were received on September 2, and a contract has been made with the Edison Electric Illuminating Company of Boston, which provides that for a term of five years that Company will take and pay \$6.25 per thousand kilowatt hours for all energy delivered to its lines at a point near the Sudbury Dam. Plans and specifications for the construction and installation of the necessary machinery are now practically finished and proposals will soon be received for doing the work.

PAYMENT BY CITY OF WORCESTER FOR TAKING OF WATER FROM
WACHUSETT WATERSHED.

Your engineer, together with Mr. F. A. McClure, City Engineer of the City of Worcester, acting under authority given by chapter 456 of the Acts of the year 1897 and chapter 351 of the year 1902, have determined that the city of Worcester shall pay to the Commonwealth of Massachusetts the sum of \$164,000 on account of its taking on August 1, 1911, of the waters of Asnebumskit Brook and Kendall Reservoir, which together form $\frac{936}{11819}$ of the watershed of the South Branch of the Nashua River, the rights in which had been previously acquired by this Board in behalf of the Commonwealth. It was further determined that subsequent to August 1, 1911, the city of Worcester should pay annually the same proportion of the cost of constructing, maintaining and operating the Clinton sewage disposal works, and should be paid the same proportion of any amounts which may be received at any time from the sale of said works. It was also further determined that until such time as an additional source of water supply embracing more than 25 square miles is obtained for the Metropolitan District, the Metropolitan Water and Sewerage Board shall pay to the city of Worcester \$2 for each million gallons of water discharged into the watershed of the

Wachusett Reservoir from the watersheds of Asnebumskit Brook and the Kendall Reservoir between June 15 and December 15 of any year, or for all water so discharged during any portion of any year in which the water in the Wachusett Reservoir does not rise to elevation 395 above Boston City Base before June 15.

MAINTENANCE.

RAINFALL AND YIELD OF WATERSHEDS.

The rainfall in the eastern portion of Massachusetts during the past year has been about 7 inches below the average of the previous 40 years. The rainfall was above the average during the first six months of the year, but below the average during the latter portion of the year. The past year was the seventh successive year when the rainfall and yield were below the average.

STORAGE RESERVOIRS.

The following table shows the total capacity of the several storage reservoirs and the elevation of and quantity of water stored in each at the beginning and end of the year:—

STORAGE RESERVOIRS.	Capacity (Gallons).	JAN. 1, 1914.		JAN. 1, 1915.	
		Eleva- tion ¹ of Water Surface.	Amount stored (Gallons).	Eleva- tion ¹ of Water Surface.	Amount stored (Gallons).
Cochituate watershed:—					
Lake Cochituate, including Dudley Pond.	2,328,300,000	143.51	2,043,900,000	142.62	1,825,000,000
Sudbury watershed:—					
Sudbury Reservoir, . . .	7,253,500,000	258.75	6,731,400,000	257.81	6,343,900,000
Framingham Reservoir No. 1, .	287,500,000	167.80	220,400,000	167.66	214,400,000
Framingham Reservoir No. 2, .	529,900,000	177.33	538,900,000	175.98	480,900,000
Framingham Reservoir No. 3, .	1,180,000,000	183.00	900,500,000	183.03	902,900,000
Ashland Reservoir, . . .	1,416,400,000	225.13	1,412,000,000	224.34	1,368,500,000
Hopkinton Reservoir, . . .	1,520,900,000	304.81	1,508,900,000	304.05	1,461,500,000
Whitehall Reservoir, . . .	1,256,900,000	337.60	1,196,300,000	337.66	1,208,000,000
Farm Pond,	167,500,000	158.46	125,400,000	158.66	136,000,000
Wachusett watershed:—					
Wachusett Reservoir, . . .	64,968,000,000	387.48	55,146,300,000	381.89	48,438,100,000
Totals,	80,908,900,000	—	69,824,000,000	—	62,379,200,000

¹ Elevation in feet above Boston City Base.

The diagram on the following page shows the quantity of water stored in the Wachusett Reservoir, also in all the storage reservoirs combined at different periods during the year. All of the reservoirs, with the exception of the Wachusett Reservoir, have been substantially full throughout the year.

Wachusett Reservoir. — Eighty-six per cent. of the water used in the Metropolitan District was drawn from this reservoir. It was 7.52 feet below high water on January 1, rose rapidly during March, and reached its greatest elevation for the year on April 1, when it was 395.43. Water was wasted from the reservoir into the river below the dam from March 29 to June 2, the total quantity wasted being 11,152,700,000 gallons. The reservoir remained full until June 13, and after that time fell at the rate of approximately 2 feet per month until the end of the year, when it was 13 feet below high water, and lower than it had been since December, 1911.

In compliance with the requirements of chapter 488 of the Acts of the year 1895, 1,043,700,000 gallons of water were discharged into the Nashua River below the dam, at the rate of not less than 12,000,000 gallons per week, for the use of the Lancaster Mills.

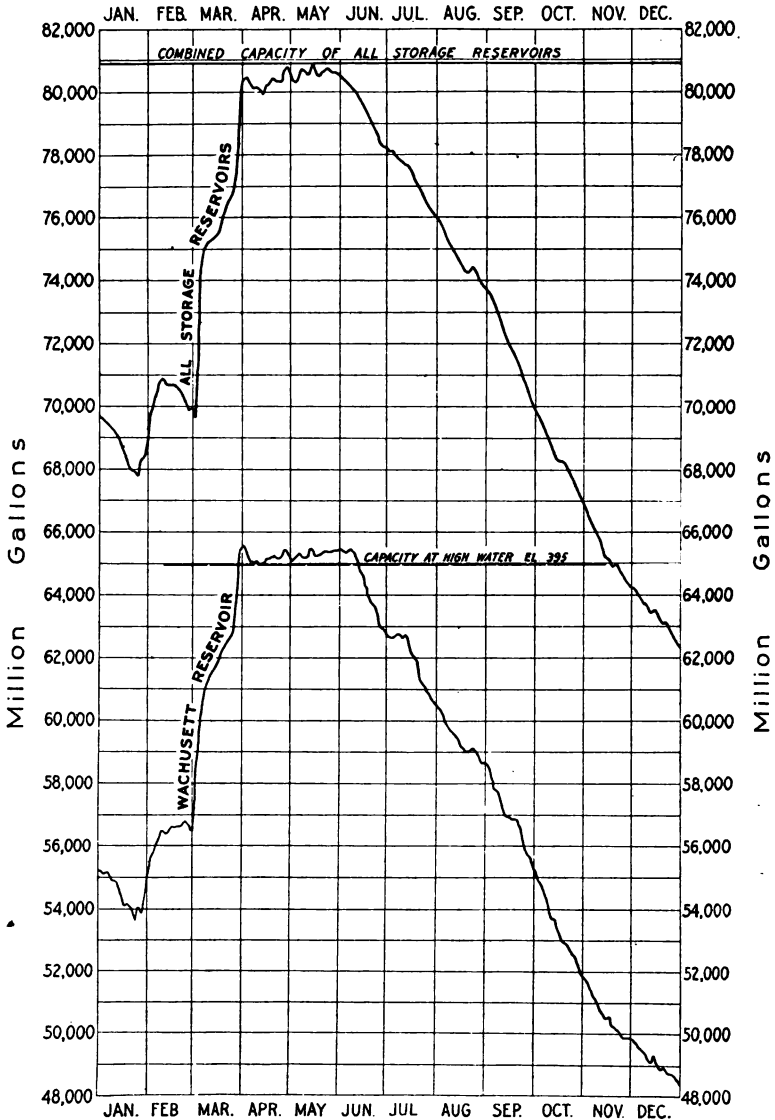
Soil has been removed from strips of land along both the northerly and southerly shores of the reservoir where the action of the waves had caused the banks to retreat beyond the limits of previous stripping. This work was carried on for an aggregate distance of 7,530 feet, in widths varying from 10 to 50 feet, the area stripped being 2.9 acres.

The area of the bottom of the reservoir which is exposed when the water is lowered 12 feet below high water is about 550 acres. During the latter portion of each year a large part of this area is exposed, and during the past seven years portions of this area have gradually become covered with a light vegetable growth which had an unsightly appearance. This growth has been removed from 266 acres of this area during the past year by harrowing the ground, raking up and burning or otherwise removing the débris. Driftwood or other débris brought into the reservoir by the spring freshets has also been removed.

All of the work above described was done at a cost of \$3,515.32, and was nearly all done between August 17 and November 7.

Fills, composed of soil faced with gravel, were constructed when the reservoir was built near the former locations of the Clarendon

DIAGRAM SHOWING
 QUANTITY OF WATER STORED IN THE WACHUSETT RESERVOIR
 AND IN ALL THE STORAGE RESERVOIRS COMBINED
 DURING 1914



and Sawyer's Mills on the northerly shore of the reservoir. As the exposed gravel facing of these fills has been removed by wave action they have been protected during the past year, near high-water line, with a paving of field stones 12 inches to 15 inches in thickness. The fill near Sawyer's Mills was protected in this manner for a length of 2,055 feet, and the Clarendon Mills fill for a distance of 615 feet. The total amount done at both places was 2,434 square yards at a cost of \$786.71, or 32 cents per square yard.

Additional riprap protection was placed for 1,750 feet on the easterly shore of the reservoir south of the dam and for a length of 260 feet just west of the southerly end of the South Dike, between November 5 and December 5, at a cost of \$837.45.

The brush and weeds have been mowed, raked up and burned from the face and riprap berm of the North and South dikes, from the sides of brooks leading into the reservoir, and from all highways facing the property of the Board. This work extended over 24 miles. The standing and rowen grass on 404 acres of the marginal lands was sold for \$3,165.

The two houses remaining in Boylston on the northerly side of the reservoir, which have been occupied by employees of the Board, have been sold, upon condition that they be removed from the town. At the Tucker house, near Boylston Centre, an artesian well 84 feet deep has been installed at a cost of \$241.29, for the purpose of securing a non-failing supply of water. The houses on Wilson Street, near the Wachusett Dam, have been resingled, repaired and externally painted.

Wachusett Dam. — The dam, with the adjacent structures and grounds, is in good condition. The sidewalk curbing, extending for 445 feet along Boylston Street, has been reset. The granite steps and granolithic landings on the slopes leading up the hillsides have been rejointed where necessary. A gravel foot-path 1,600 feet long has been built along the southerly side of the waste channel. Fourteen hundred white pine seedlings have been set out in the vicinity of the garage, along the banks of the waste channel, and on the shore of the reservoir west of the dam.

An electrically operated appliance for opening and closing the 8 sluice gates which control the discharge from the reservoir has been installed at a cost of \$262.51. The apparatus consists of a 5 horsepower Westinghouse motor, attached to the traveling crane in the

gate chamber in such a manner that the motor can be used interchangeably to operate any of the gates.

The piping and valves which control the operation of the 48-inch gates on the pipes leading to the pool below the dam have been brought above the main floor of the power station so as to be more conveniently accessible in case of emergency. This work cost \$266.67.

Sudbury Reservoir. — During the early portion of the year the water in this reservoir was kept near the elevation of the stone crest of the dam, but after the middle of April flash-boards were placed on the crest and the water raised to high-water mark. The flash-boards were removed on November 28 and on January 1, 1915, the reservoir was 1.19 feet below the stone crest of the overflow.

The location of the entrance from the Framingham-Marlborough road to the dam has been changed for a distance of 305 feet from the street, so as to afford convenient entrance for automobiles from either direction. The reconstruction of the driveway and shrubbery beds necessitated by this change has improved the appearance of the entrance.

Minor repairs to houses owned by the Board at Fayville and Marlborough have been made. The shores of the reservoir and the grounds at the dam have received the necessary attention and are in good condition.

Framingham Reservoirs Nos. 1 and 2. — No water was drawn during the year from these reservoirs for the use of the Metropolitan District, and they remained substantially full throughout the year. On November 11 and 12 water was drawn from both of these reservoirs for the purpose of filling Farm Pond. A wire fence has been built for a length of 265 feet along the property line of the Board on the southerly side of Fountain street.

Framingham Reservoir No. 3. — About 64 per cent. of the supply furnished to the Metropolitan District passed through this reservoir. Its surface was kept about $3\frac{1}{2}$ feet below high water during January and February, after which it was allowed to rise to high-water mark in April and May, so that small quantities of water were wasted into Framingham Reservoir No. 1 during 15 days in April and 8 days in May. During the remainder of the year the reservoir was kept from 2 to $2\frac{1}{2}$ feet below high-water mark.

Several parcels of land aggregating 20.94 acres have been purchased for the purpose of widening the property of the Board along the shores of this reservoir, thus affording better protection from pollution for the water.

A wire fence 489 feet long was built between land thus acquired and land of Andrew O. Stensson on the west side of the Framingham-Marlborough road. Six points have been marked on the boundary lines of the Water Works lands at this reservoir.

Miscellaneous Work in Cedar Swamp. — Considerable work has been done in connection with the determination and marking of the boundary lines of the Metropolitan Water Works lands in Cedar Swamp and along the Sudbury River to Framingham Reservoir No. 2, and 235 points on these boundary lines have been permanently marked. The trees and brush have been cut and removed along the property lines in Cedar Swamp for a width of 5 feet and a distance of 28,374 feet. Three hundred and forty-five feet of wire fence have been built and 300 feet of stone wall repaired between land of the Board and Harry F. Rogers.

Ashland, Hopkinton and Whitehall Reservoirs. — No water was drawn from any of these reservoirs for the supply of the Metropolitan District. Both the Ashland and Hopkinton reservoirs were lowered about 2 feet below the stone crests of the wasteways in March, in order to provide storage in case of freshets. They refilled before April 1 and during the remainder of the year all three of the reservoirs remained substantially full.

The grounds at the several dams have received the usual attention and are in good condition.

Four points on the boundary lines of the Water Works lands at the head of Hopkinton Reservoir have been permanently marked, and 29 at the Ashland Reservoir. A wire fence was built on the north side of the property line below the Ashland Dam, extending 920 feet westerly from Chestnut Street. The supply of water to the attendant's house at this reservoir has been improved by laying a 1½-inch diameter galvanized iron pipe 360 feet long between the house and the reservoir. The end of the pipe was carried 22 feet below high water in the reservoir.

Between December 19 and 22 the town of Hopkinton pumped about 180,000 gallons of water from Whitehall Pond to replenish the supply in the local standpipe of the town.

Lanes 5 feet in width were cut along the property lines between the land of the Board and adjoining owners at the Hopkinton Reservoir for a distance of 5,880 feet, and at Whitehall Reservoir for a distance of 13,218 feet.

During the year five summer cottages were taken down near the Whitehall Reservoir and none built, leaving 56 now located near the shores. The number of boats of all kinds used on Whitehall Reservoir is now 113, or 16 less than one year ago.

Farm Pond. — The town of Framingham drew 252,900,000 gallons of water from the filtering gallery which is maintained alongside the pond, and 41,400,000 gallons from the Sudbury Aqueduct directly to its pumps. The pond was replenished by a flow amounting to 109,600,000 gallons, drawn from Framingham Reservoirs Nos. 1 and 2 on November 11 and 12.

Permission has been given the town of Framingham to use about 2.3 acres of land, extending about 1,300 feet along the westerly shore of the pond as a playground in connection with adjacent land owned by the town.

Lake Cochituate. — No water for the use of the Metropolitan District was drawn from the lake. The property of the Board surrounding the lake has received the usual care, the debris has been removed from the shores; the channels and sand catcher on the surface drainage system from Cochituate Village have been cleaned and repaired, and the lake and grounds are now in good condition.

SOURCES FROM WHICH WATER FOR THE SUPPLY OF THE METROPOLITAN DISTRICT HAS BEEN TAKEN.

A daily average of 92,420,000 gallons of water was drawn from the Wachusett Reservoir into the Sudbury Reservoir. Water for use in the Metropolitan District was drawn as follows: —

	Daily Average Gallons.
From the Sudbury Reservoir through the Weston Aqueduct,	37,643,000
From Framingham Reservoir No. 3 through the Sudbury Aqueduct,	67,564,000
From the drainage area of Spot Pond,	213,000
Total,	105,420,000

AQUEDUCTS.

The Wachusett Aqueduct carried water during the whole or a portion of 291 days. The total quantity conveyed was 33,800,200,000 gallons, of which amount 66,749,000 gallons, equivalent to 183,000 gallons per day, was taken for the Westborough State Hospital, and the remainder delivered into the Sudbury Reservoir.

During the month of September the bottom and side slopes of the open channel, extending up-stream 2,900 feet from the upper dam, were thoroughly cleaned by the removal of water grass, weeds and muck, which had accumulated during the 16 years since the aqueduct was placed in service. This work cost \$329.21. At the same time the masonry of the upper dam, Stone's bridge and the retaining walls of the terminal chamber were repointed.

Electrically welded wire fencing, erected in 1897, was replaced by a No. 65 Wheelock wire fence for a distance of 1,125 feet along the north side of the open channel just above the upper dam, at a cost of \$201.37, and 7,882 feet of board fencing on both sides of the aqueduct between Derby Road and Linden Street, in Berlin, was replaced with the same pattern of wire fence, at a cost of \$970.48. An area of $11\frac{1}{2}$ acres in Marlborough and Northborough, lying on the south side of the open channel and about $\frac{1}{4}$ of a mile below the terminal chamber, has been cleared of oak, birch, apple and chestnut trees which were badly infested with moths. This work cost \$834.97, which was reduced by \$196 received for wood sold. About $1\frac{3}{4}$ acres of land west of the terminal chamber has been filled and graded at a cost of \$329.80, and the appearance of the property improved.

The aqueduct embankment in Berlin has been regraded, fertilized with super-phosphate and muriate of potash, planted with witch grass and seeded for a distance of 860 linear feet, covering $\frac{3}{4}$ of an acre, at a cost of \$211.62.

Eight hundred white pine seedlings were set out on the south side of the open channel for a distance of 1,500 feet.

At the Assabet Bridge where the aqueduct crosses the Assabet River, a few small leaks have developed through the masonry, which would indicate that the lead lining at this place is perforated. A careful examination of the interior of the aqueduct has disclosed fine cracks through the brickwork, but it has not yet been deter-

mined whether these cracks extend through the lead lining. The amount of water lost by leakage is inconsiderable, but the freezing of the moisture in the seams of the masonry would in time disintegrate the structure and repairs will be necessary in the near future.

The *Sudbury Aqueduct* was used every day in the year. On November 11 and 12 it was used for carrying 109,600,000 gallons of water from Framingham Reservoirs Nos. 1 and 2 to Farm Pond. The remainder of the time it was in constant use conveying a daily average of 67,564,000 gallons to Chestnut Hill Reservoir.

Fences, having two 2-inch x 6-inch spruce rails, have been built for an aggregate length of 887 feet, and minor repairs have been made to several of the structures connected with the aqueduct.

A fire occurred in the east siphon chamber of this aqueduct on August 23, which destroyed 27 stop-planks and slightly injured the interior of the building. It is supposed to have been caused by boys and to have been of careless or incendiary origin.

Manhole covers, iron doors and other portions of structures along the aqueduct have been painted.

Along the *Cochituate Aqueduct* the culverts and other structures connected with the aqueduct have been kept in repair and the aqueduct has been maintained in readiness for use, but no water was drawn through it during the year.

The *Weston Aqueduct* was in continuous use and carried a daily average of 37,643,000 gallons from the Sudbury Reservoir to the Metropolitan District. About 238,000 square feet of the embankments of this aqueduct was dressed with loam and chemical fertilizer, and 4,442 feet of cable wire fencing which had been destroyed by iron rust was replaced with No. 65 Wheelock wire fencing. The masonry has been repointed where necessary at gaging chamber No. 1, at the culverts at Angelico Brook, Baiting Brook, west of Millwood Street and near the east portal of tunnel No. 2. The exterior of the house occupied by one of the Board's employees at Nobscot, the woodwork at siphon chamber No. 4 and gaging chambers Nos. 1 and 2 and the manhole covers and iron fence of the bridge over the Sudbury River have been painted.

PUMPING STATIONS.

Sixty-five per cent. of the water supplied to the Metropolitan District has been pumped at the two stations at Chestnut Hill Reservoir, and the remainder has been delivered by gravity. The total quantity pumped at the five stations was 28,731,160,000 gallons, which was 0.2 per cent. more than in 1913. The cost of operating the stations was \$104,806.20, equivalent to \$3.648 per million gallons pumped. The cost per million gallons shows an increase of \$0.224, due entirely to an increase in the cost of repairs.

Coal for use at the several stations has been delivered into the bins as follows:—

BY WHOM FURNISHED.	GROSS TONS.					Cost per Gross Ton, in Bins. ¹
	Chestnut Hill Pumping Station No. 1.	Chestnut Hill Pumping Station No. 2.	Spot Pond Station.	Arlington Station.	Hyde Park Station.	
Gorman-Leonard Coal Company, bituminous,	946.88	-	-	-	-	4.10
Gorman-Leonard Coal Company, bituminous,	-	4,471.33	-	-	-	4.00
C. W. Claffin & Co., buckwheat anthracite,	79.55	-	-	-	-	3.16
C. W. Claffin & Co., buckwheat anthracite,	-	596.84	-	-	-	2.90
Gorman-Leonard Coal Company, buckwheat anthracite,	-	36.12	-	-	-	2.84
Locke Coal Company, bituminous,	-	-	325.14	-	-	5.13
Bader Coal Company, bituminous,	-	-	488.78	-	-	5.08
Locke Coal Company, screenings,	-	-	164.09	-	-	2.50
Bader Coal Company, bituminous,	-	-	-	189.42	-	4.46
Bader Coal Company, bituminous,	-	-	-	268.42	-	4.21
Gorman-Leonard Coal Company, bituminous,	-	-	-	-	182.90	4.11
Gorman-Leonard Coal Company, bituminous,	-	-	-	-	47.06	4.17
Total gross tons, bituminous,	946.88	4,471.33	813.92	457.84	229.96	-
Total gross tons, anthracite,	79.55 ²	632.96 ²	-	-	-	-
Total gross tons, anthracite screenings,	-	-	164.09	-	-	-
Average price per gross ton, bituminous,	4.10	4.00	5.10	4.31	4.12	-
Average price per gross ton, anthracite,	3.16 ²	2.90 ²	-	-	-	-
Average price per gross ton, anthracite screenings,	-	-	2.50	-	-	-

¹ Includes cost of unloading coal from cars and all expenses incidental to storage of the coal.

² Buckwheat.

Tests of the coal used during the year have given the following results: —

KIND OF COAL.	Number of Samples tested.	British Thermal Units.	Percent- age of Volatile Matter.	Percent- age of Ash.	Percent- age of Moisture.	Percent- age of Fixed Carbon.
Beaver Run,	59	14,462	17.12	8.60	3.34	74.28
New River,	10	14,788	17.40	6.36	2.59	76.24
Georges Creek,	4	14,363	18.27	8.83	2.04	72.90
Sterling,	3	14,640	20.78	7.70	2.27	71.52
Cardiff,	1	14,885	18.96	5.79	3.23	75.25
Unclassified,	2	14,036	26.13	9.76	2.07	64.11

All bituminous coal giving less than 14,700 British thermal units or more than 8 per cent. of ash has been purchased subject to a reduction in price.

Chestnut Hill Pumping Stations.

At these stations a daily average of 33,690,000 gallons of water was raised 122.34 feet for the supply of the southern high-service district, and a daily average of 36,240,000 gallons was raised 40.18 feet for the supply of the low-service and the northern high-service districts. These figures show an increase of 1,391,000 gallons per day in the quantity pumped for the southern high-service and a decrease of 1,411,000 gallons per day in the quantity pumped for the low-service and northern high-service districts. Statistics relative to the operation of the several engines at these stations are as follows: —

	PUMPING STATION No. 1.			PUMPING STATION No. 2.	Totals.
	Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.	Engine No. 12.	
Daily pumping capacity (gallons),	16,000,000 ¹	20,000,000	30,000,000	40,000,000	106,000,000
Total quantity pumped (million gallons),	387.03	14.92	1,128.61	10,786.30	12,296.86
Daily average quantity pumped (gallons),	1,006,000	41,000	3,092,000	29,551,000	33,690,000
Coal used in pumping (pounds),	1,071,135	15,455	790,635	7,198,460	9,075,685
Gallons pumped per pound of coal,	342.66	965.38	1,427.47	1,498.42	1,354.92
Average lift (feet),	133.12	117.43	119.62	122.26	122.34
Cost of pumping: —					
Labor,	\$2,585 13	\$88 91	\$4,164 93	\$12,579 65	\$19,418 62
Fuel,	2,028 41	29 40	1,474 26	12,457 57	15,989 64
Repairs,	2,511 98	118 70	4,041 03	1,199 86	7,871 57
Oil, waste and packing,	25 19	87	40 58	293 79	360 43
Small supplies,	78 00	4 75	128 88	163 28	374 91
Totals,	\$7,228 71	\$242 63	\$9,849 68	\$26,694 15	\$44,015 17
Cost per million gallons pumped,	\$19.6951	\$16.2621	\$8.7273	\$2.4748	\$3.5794
Cost per million gallons raised 1 foot high, . . . . .	.1479	.1385	.0730	.0202	.0293

¹ 8,000,000 each.

Chestnut Hill
Pumping Station
No. 2. — Engines
Nos. 5, 6 and 7.

Daily pumping capacity each engine (gallons),	35,000,000
Total quantity pumped (gallons),	13,227,750,000
Daily average quantity pumped (gallons),	36,240,000
Total coal used (pounds),	4,579,640
Gallons pumped per pound of coal,	2,888.38
Average lift (feet),	40.18

Cost of pumping: —

Labor,	\$18,328 57
Fuel,	7,874 00
Repairs,	3,212 01
Oil, waste and packing,	333 53
Small supplies,	237 89
Total,	<u>\$29,986 00</u>

Cost per million gallons pumped,	\$2.2669
Cost per million gallons raised 1 foot high, . . . . .	.0564

The cost of pumping at these stations was larger than during the previous year, due, in both cases, to the cost of repairs made upon the plant.

At Station No. 1 the Green fuel economizer which has been in continuous use for 20 years has been replaced by one of larger size, built by the B. F. Sturtevant Company at an expense, including installation, of \$2,437.85. Concrete piers and steel beams have been placed under the 90-inch Belpaire boiler and under the new economizer, at a cost of \$1,833. This work was done for the purpose of preventing further settlement of these structures. In connection with the strengthening of the boiler and economizer foundation 1,830 square feet of the boiler-room floor was relaid with Barrington paving brick set on edge in Portland cement mortar on a concrete foundation 4 inches in thickness. The brick smoke flues which pass under the boiler-room floor were repaired and the floor drains repaired and relaid. The cost of work upon the floor, flues and drains was \$2,044.66. A 24-inch Pelton water motor was installed at a cost of \$546.25, for use in operating the machinery in the repair shop connected with the station. Power for operating the machinery used in making repairs is thus economically obtained as the water used in operating the motor is returned to the supply and not wasted. Repairs were made upon the copper portion of the station roof by W. J. Maguire at a cost of \$210.

At Station No. 2 a 20-inch pipe line, connecting the pipe leading from the Weston Aqueduct with the supply wells of the station and provided with a valve and Venturi meter for controlling and measuring the flow of water, has been installed for use in controlling the pressure upon the Boston low-service pipe system and also for measuring the water delivered from the Weston Reservoir into the Chestnut Hill Reservoir. This work, which cost \$1,811.07, was completed and placed in service on July 1 and has since that time worked satisfactorily.

The Howe scales which are used for weighing ashes from the boiler furnaces have been in the past located in a tunnel under the boilers, where the working parts of the scale have rapidly deteriorated, due to the presence of moisture and sulphurous gases. The scales have been repaired and reset in a new location on the line of the track leading from the station to the ash dump, at a cost of \$176.62.

Spot Pond Pumping Station.

The record shows an increase of 3.38 per cent. in the quantity of water pumped and 10.21 per cent. in the cost of pumping.

The following are statistics relating to operations at this station, where water is pumped to the Fells and Bear Hill reservoirs for the supply of the northern high-service district: —

Total quantity pumped (gallons),	2,688,880,000
Daily average quantity pumped (gallons),	7,367,000
Total coal used (pounds),	2,412,976
Gallons pumped per pound of coal,	1,114.34
Average lift (feet),	131.84
Engine No. 8 operated (hours),	213
Engine No. 9 operated (hours),	3,134
Quantity pumped by Engine No. 8 (gallons),	91,780,000
Quantity pumped by Engine No. 9 (gallons),	2,597,100,000

Cost of pumping: —

Labor,	\$9,351 67
Fuel,	4,970 96
Repairs,	603 42
Oil, waste and packing,	268 97
Small supplies,	199 09
Total for station,	\$15,394 11

Cost per million gallons pumped,	\$5.7251
Cost per million gallons raised 1 foot high, . . . . .	.0434

Arlington Pumping Station.

At this station there was an increase of 5.82 per cent. in the quantity pumped and of 3.4 per cent. in the cost of operation. The statistics relative to the operation of the station for the year 1914 are as follows:—

Total quantity pumped (gallons),	262,000,000
Daily average quantity pumped (gallons),	718,000
Total coal used (pounds),	1,049,753
Gallons pumped per pound of coal,	249.58
Average lift (feet),	281.83
Engine No. 10 operated (hours),	5,350
Engine No. 11 operated (hours),	734
Quantity pumped by Engine No. 10 (gallons),	241,890,000
Quantity pumped by Engine No. 11 (gallons),	20,110,000

Cost of pumping:—

Labor,	\$5,505 64
Fuel,	2,090 59
Repairs,	341 86
Oil, waste and packing,	102 23
Small supplies,	119 26

Total for station,	\$8,159 58
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Cost per million gallons pumped,	\$31.1434
Cost per million gallons raised 1 foot high,1105

Hyde Park Pumping Station.

There was a decrease of 37,220,000 gallons, equivalent to 12.71 per cent., in the quantity pumped from this station, and a decrease of \$870.59, equivalent to 10.72 per cent., in the cost of operation. It is expected that the cost of operating this station will be further reduced during the coming year by the completion and use of the steel reservoir on Bellevue Hill, with its increased storage capacity.

The statistics relative to the operation of this station for the year 1914 are as follows:—

Total quantity pumped (gallons),	255,670,000
Daily average quantity pumped (gallons),	700,000
Total coal used (pounds),	508,426
Gallons pumped per pound of coal,	502.87
Average lift (feet),	120.63

Engine No. 13 operated (hours),	1,604
Engine No. 14 operated (hours),	5,310
Quantity pumped by Engine No. 13 (gallons),	56,460,000
Quantity pumped by Engine No. 14 (gallons),	199,210,000

Cost of pumping:—

Labor,	\$5,602 85
Fuel,	952 67
Repairs,	361 00
Oil, waste and packing,	164 92
Small supplies,	169 90
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Total for station,	\$7,251 34

Cost per million gallons pumped,	\$28.3621
Cost per million gallons raised 1 foot high,2351

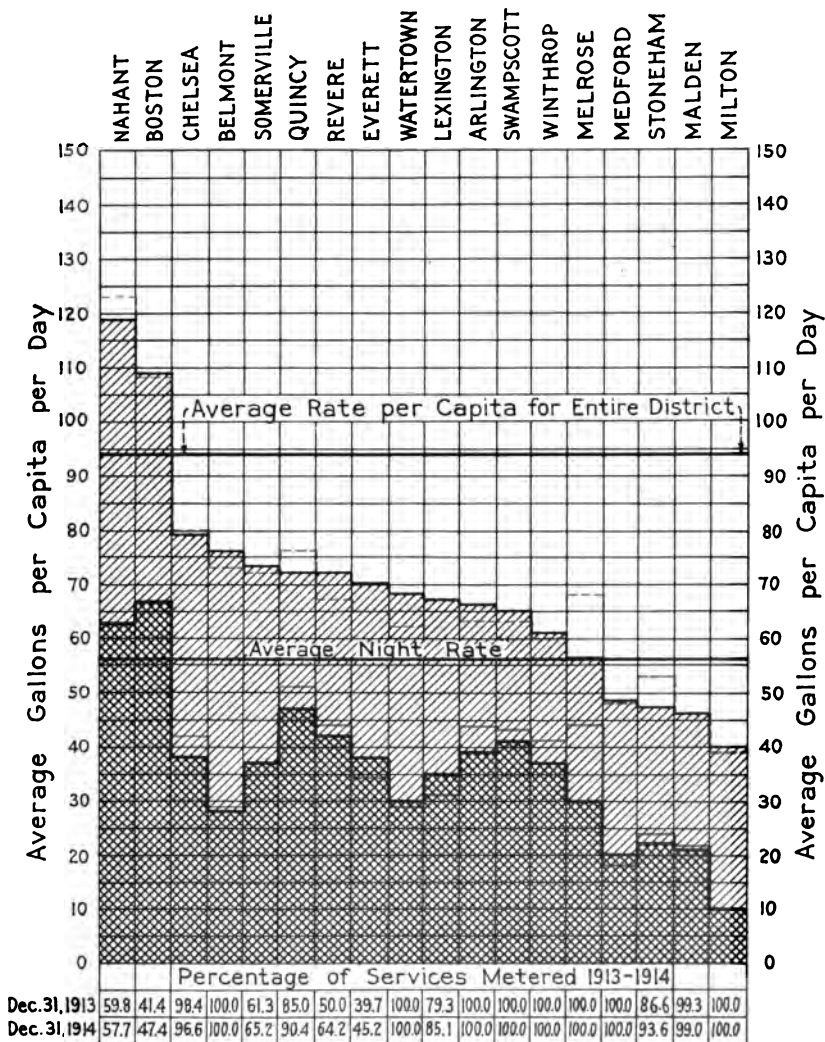
During the year the old machinery which had been used at the West Roxbury Pumping Station and supplanted by the construction of the Hyde Park Station, consisting of 2 54-inch diameter boilers, 1 60-inch diameter boiler, 2 1,000,000-gallon capacity Worthington compound direct-acting steam pumps, 1 1,750,000-gallon capacity Knowles pump and a Worthington type of condenser were sold to Louis E. Miller of East Boston for the sum of \$604.08.

CONSUMPTION OF WATER.

The daily average quantity of water consumed in the 18 municipalities supplied from the Metropolitan Works during the year 1914, as measured by Venturi meters, was 107,036,100 gallons, equivalent to 94 gallons per capita in the district supplied. This quantity was 3,188,400 gallons per day more than during the previous year, but exactly the same per inhabitant. Figures showing in detail the consumption in the several municipalities at different periods throughout the year indicate that the saving which has been effected during the past year by the introduction of meters has been offset by the increase in the use of water during the extreme cold and dry weather.

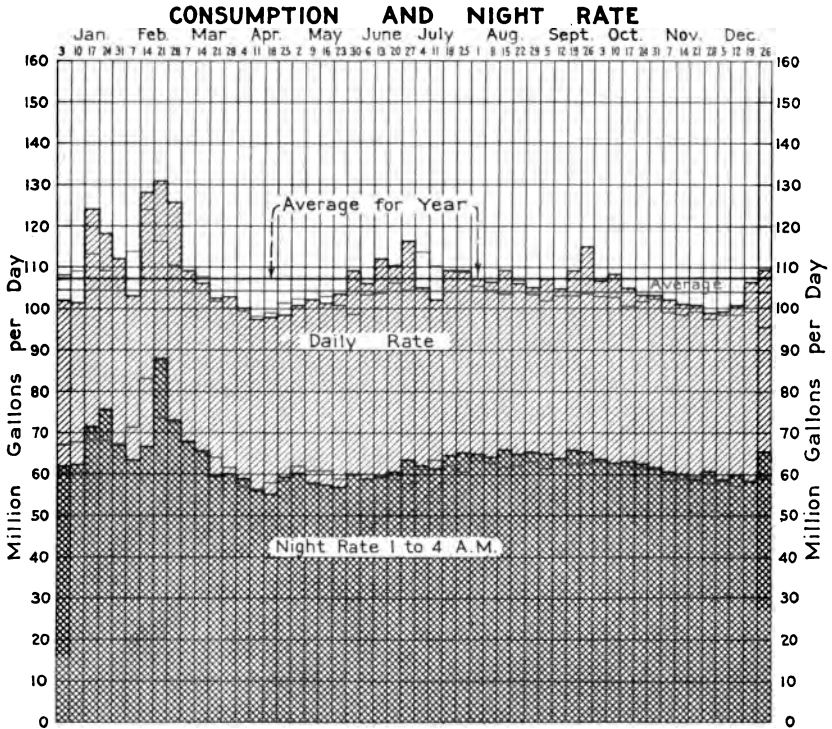
The daily average consumption of water in each of the cities and towns supplied from the Metropolitan Works during the years 1913 and 1914, as shown by meters, was as follows:—

DIAGRAM SHOWING
AVERAGE RATE OF CONSUMPTION OF WATER
IN THE METROPOLITAN DISTRICT IN 1914
DURING THE ENTIRE DAY
AND
BETWEEN THE HOURS OF 1 AND 4 AT NIGHT

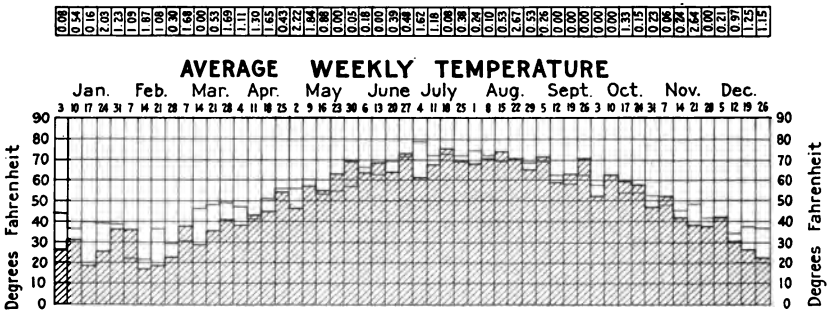


Daily Average Rate of Consumption 1914
 " " " Night between 1 A.M. and 4 A.M. 1914
 Daily Average Rate of Consumption in 1913 shown in Red.

AVERAGE RATE OF CONSUMPTION
 IN
 METROPOLITAN WATER DISTRICT
 AND
 RAINFALL AND AVERAGE TEMPERATURE OF AIR AT CHESTNUT HILL RESERVOIR
 FOR
 EACH WEEK DURING 1914



RAINFALL IN INCHES



Averages for 1913 shown in Red.

	Estimated Popula- tion, 1914.	DAILY AVERAGE CONSUMPTION.				
		1913.		1914.		Increase in Gallons.
		Gallons.	Gallons per Capita.	Gallons.	Gallons per Capita.	
Boston,	747,830	79,390,600	108	81,877,800	109	2,487,200
Somerville,	84,530	5,958,000	72	6,199,800	73	241,800
Malden,	48,950	2,225,700	46	2,237,900	46	12,200
Chelsea,	36,910	2,879,800	80	2,904,400	79	24,600
Everett,	38,500	2,435,800	65	2,688,100	70	252,300
Quincy,	36,410	2,699,100	76	2,609,200	72	89,900 ¹
Medford,	26,430	1,233,700	48	1,258,900	48	25,200
Melrose,	16,920	1,136,600	68	932,500	55	204,100 ¹
Revere,	21,460	1,385,100	67	1,551,000	72	165,900
Watertown,	14,430	868,500	62	984,800	68	116,300
Arlington,	12,970	786,300	63	860,500	66	74,200
Milton,	8,630	332,300	39	346,700	40	14,400
Winthrop,	11,820	689,700	60	722,800	61	33,100
Stoneham,	8,070	414,400	53	378,800	47	35,600 ¹
Belmont,	6,560	463,600	73	497,500	76	33,900
Lexington,	5,550	359,300	67	373,800	67	14,500
Nahant,	1,440	169,100	123	171,600	119	2,500
Swampscott,	6,770	420,100	63	440,000	65	19,900
District,	1,134,180	103,847,700	94	107,036,100	94	3,188,400

¹ Decrease.

The consumption in the several districts was as follows: —

	Gallons per Day, 1914.	Increase (Gallons per Day).	Percent- age of Increase.
Southern low-service district, embracing the low-service district of Boston, with the exception of Charlestown and East Boston,	45,353,100	267,900	0.59
Northern low-service district, embracing the low-service districts of Somerville, Chelsea, Malden, Medford, Everett, Arlington, Charlestown and East Boston,	20,492,500	425,300	2.12
Southern high-service district, embracing Quincy and Watertown, the high-service districts of Boston, and portions of Belmont and Milton,	32,185,200	2,306,200	7.72
Northern high-service district, embracing Melrose, Revere, Winthrop, Swampscott, Nahant and Stoneham, and the high-service districts of Somerville, Chelsea, Malden, Medford, Everett and East Boston,	7,536,200	174,700	2.37
Southern extra high-service district, embracing the higher portions of Hyde Park, Milton and West Roxbury,	745,400	31,200 ¹	4.02 ¹
Northern extra high-service district, embracing Lexington and the higher portions of Arlington and Belmont,	723,700	45,500	6.71
Totals,	107,036,100	3,188,400	3.07

¹ Decrease.

Fifteen of the eighteen municipalities show an increase in the total use of water, but in only ten was there an increase in the quantity used per capita.

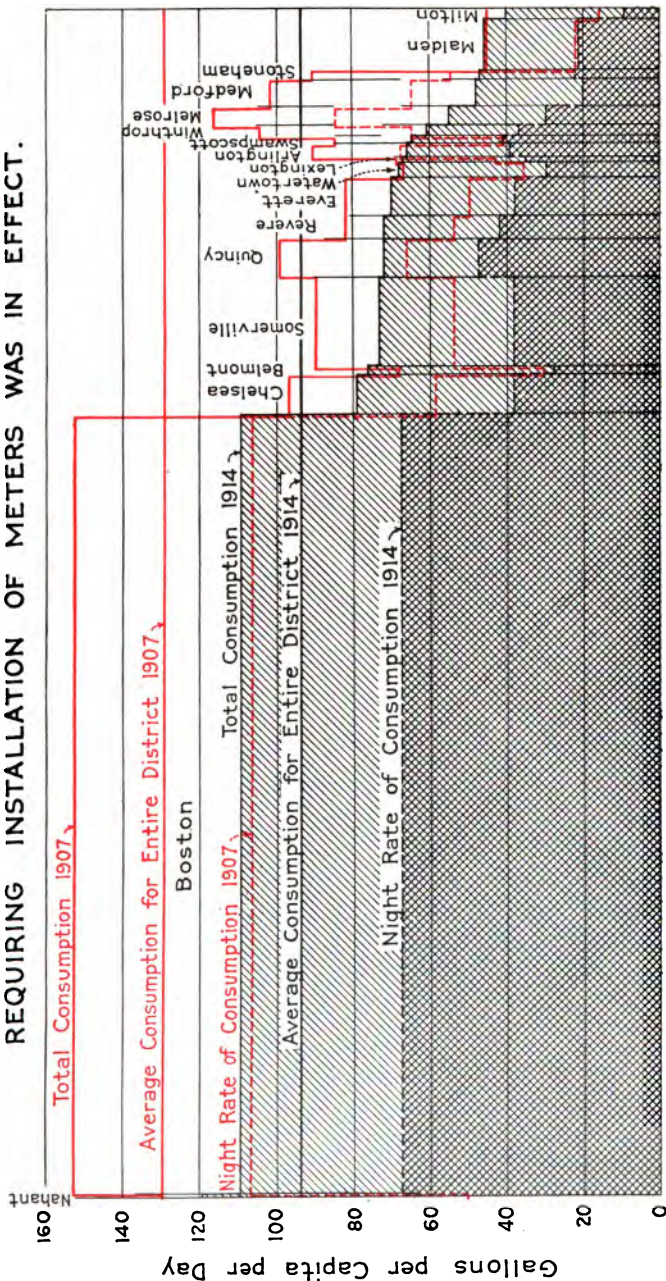
The diagram facing this page shows graphically what has been accomplished in the Metropolitan District during the past seven years in reducing the waste of water, and at the same time indicates that while much has been accomplished the work is still unfinished.

The conditions governing the use of water in the Metropolitan District are such that it seems probable that the total daily use of water in the District, which is now as low as it was thirteen years ago, notwithstanding an increase of about 300,000 in the number of people supplied, will not be further reduced; but the completion of the application of meters to all services, together with measures which should be taken to reduce the leakage from the street mains and services, will result in a reduction of the per capita consumption for several years.

Metering of Service Pipes.

The placing of meters on all new services and on 5 per cent. of those unmetered on December 31, 1907, in conformity with chapter 52 of the Acts of the year 1907, has been continued during the year, and the following table shows the results accomplished in the several municipalities:—

DIAGRAM OF PER CAPITA USE OF WATER AND COMPARATIVE VOLUME USED IN THE CITIES AND TOWNS SUPPLIED BY THE METROPOLITAN WATER WORKS DURING 1914, AND DURING 1907 BEFORE ACT REQUIRING INSTALLATION OF METERS WAS IN EFFECT.



Estimated Population July 1, 1914, Boston 747,830, District 1,134,180.
Horizontal space given to different municipalities in proportion to their population.
Use of water during 1907 shown in red.



CITY OR TOWN.	Number of Meters re- quired to be set on Old Services Each Year.	METERS SET ON OLD SERVICES.							New Services installed, 1914. ¹	New Services equipped with Meters, 1914. ¹	Services in Use Decem- ber 31, 1914.	Meters in Use December 31, 1914.	Per Cent. of Services metered December 31, 1914.
		1906.	1909.	1910.	1911.	1912.	1913.	1914.					
Boston,	4,276	84	5,503	5,481	6,487	6,022	5,600	5,897	1,492	1,235	101,952	48,360	47.43
Somerville,	411	732	621	501	570	488	508	422	230	231	13,032	8,499	65.22
Malden,	14	43	62	8	2	2	2	3	126	98	7,684	7,609	99.02
Chelsea,	240	198	756	779	1,092	132	33	6	98	98	4,795	4,795	96.58
Everett,	262	338	255	277	285	215	235	261	85	85	6,788	2,604	45.15
Quincy,	280	358	33	423	1,680	1,090	647	193	393	497	8,070	8,070	90.37
Medford,	179	857	927	1,555	1,178	6	7	4	357	368	6,442	6,443	100.00
Melrose,	119	2,432	135	7	5	6	157	—	135	96	3,914	4,131	100.00
Revere,	138	85	184	110	176	154	157	487	233	220	2,692	2,692	64.23
Watertown,	—	—	56	63	127	—	349	—	156	156	2,573	2,581	100.00
Arlington,	55	108	—	63	—	261	—	—	127	130	2,526	2,530	100.00
Milton,	—	—	—	—	—	—	—	—	86	86	1,760	1,760	100.00
Winthrop,	100	213	975	706	6	—	—	8	81	72	2,821	2,747	100.00
Stonham,	65	116	225	186	165	252	189	—	48	49	1,581	1,480	93.61
Belmont,	—	—	—	—	—	—	—	—	102	102	1,330	1,330	100.00
Lexington,	32	113	70	56	86	95	4	48	58	58	1,113	947	85.09
Nahant,	16	30	40	26	18	17	4	15	25	26	645	378	57.71
Swampscott,	21	264	142	28	13	—	—	—	58	58	1,748	1,748	100.00
Totals,	6,148	5,971	9,984	10,206	10,890	8,732	7,735	7,444	3,882	3,665	171,884	107,704	62.57

¹ The number of new meters installed and the number of new services equipped with meters seldom agree for the reason that service pipes are installed but meters are not set until the buildings are permanently occupied.

The requirements of the law relative to the metering of services have been complied with in all municipalities with the exception of Quincy, where more than the required number were set on old services but where there is still a deficiency in the number required on new services installed in previous years. In twelve of the municipalities water is now supplied through meters to substantially all of the takers.

In Boston the records indicate that approximately one-half of the services are still unmetered, but it is probable that the total number of services recorded is excessive and that the number actually in use is less than the number stated.

During the year there was a net increase of 10,579 in the number of meters used in the several municipalities, and at the end of the year 62.57 per cent. of the 171,884 services were provided with meters.

WATER SUPPLIED OUTSIDE THE METROPOLITAN DISTRICT.

During the year 1914, 517,284,200 gallons of water were supplied by the Metropolitan Works for use outside the Metropolitan District, as follows:—

PLACES SUPPLIED.	Total Quantity (Gallons).	Average Daily Quantity (Gallons).	Length of Time during which Water was supplied (Days).	Amounts charged for Water supplied.
Westborough State Hospital,	66,749,000	183,000	356	\$2,002 47
Town of Framingham:—				
From Framingham Reservoir No. 3,	41,400,000	113,427	282	} 1,478 61
From Filter-gallery at Farm Pond,	252,900,000	692,677	365	
United States Government:—				
Peddock's Island,	39,800,000	109,000	365	2,537 21
Town of Saugus,	5,002,200	13,700	365	250 00
Town of Wakefield,	111,433,000	305,300	187	7,800 31

QUALITY OF WATER.

About 86 per cent. of the water used in the Metropolitan District during the year was drawn from the Wachusett Reservoir, and the remainder from the Sudbury Reservoir and Framingham Reservoir No. 3, through which the supply from the Wachusett Reservoir was also drawn. The water delivered to the water takers has been of substantially the same quality as that furnished during the past few years.

The average results of the examinations of water drawn from a tap in Boston for alternate years since 1898 are given in the following table, and tables giving further details of the chemical and biological examinations of the water will be found in Appendix No. 2.

	1898.	1900.	1902.	1904.	1906.	1906.	1910.	1912.	1914.
STATE BOARD OF HEALTH EXAMINATIONS.									
Color (platinum standard), . . .	0.40	0.29	0.30	0.23	0.24	0.19	0.14	0.17	0.14
Total residue, . . .	4.19	3.80	3.93	3.93	3.86	3.50	3.05	3.86	4.12
Loss on ignition, . . .	1.60	1.20	1.56	1.59	1.39	1.35	1.24	1.23	1.19
Free ammonia, . . .	0.0008	0.0012	0.0016	0.0023	0.0018	0.0011	0.0013	0.0018	0.0014
Albuminoid { total, . . .	0.0152	0.0157	0.0139	0.0139	0.0159	0.0115	0.0118	0.0154	0.0138
{ dissolved, . . .	0.0136	0.0138	0.0119	0.0121	0.0134	0.0092	0.0102	0.0119	0.0116
{ ammonia, { suspended, . . .	0.0016	0.0019	0.0020	0.0018	0.0025	0.0024	0.0016	0.0034	0.0022
Chlorine, . . .	0.29	0.25	0.29	0.34	0.34	0.33	0.28	0.36	0.39
Nitrogen as nitrates, . . .	0.0097	0.0076	0.0092	0.0110	0.0054	0.0092	0.0030	0.0062	0.0076
Nitrogen as nitrites, . . .	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000
Oxygen consumed, . . .	0.44	0.38	0.40	0.37	0.36	0.26	0.22	0.29	0.25
Hardness, . . .	1.4	1.3	1.3	1.5	1.3	1.2	1.1	1.7	1.4
METROPOLITAN WATER AND SEWERAGE BOARD EXAMINATIONS.									
Color (platinum standard), . . .	0.40	0.34	0.33	0.32	0.25	0.22	0.18	0.17	0.16
Turbidity, . . .	—	—	2.3	2.4	2.2	2.4	2.1	2.2	2.0
Total organisms, . . .	230	468	367	303	550	695	421	967	549
Amorphous matter, . . .	131	97	34	36	42	64	72	141	88
Bacteria, . . .	96	181	164	176	154	148	213	259	220

NOTE. — Chemical analyses are in parts per 100,000, organisms and amorphous matter in standard units per cubic centimeter, and bacteria in number per cubic centimeter. The standard unit has an area of 400 square microns, and by its use the number of Diatomaceæ are decreased, and the number of Chlorophyceæ and Cyanophyceæ are very much increased, as compared with the number of organisms.

In connection with this branch of the work 2,050 microscopical and 1,674 bacterial examinations of the water from various points on the works have been made in the laboratory of the Board, and the results of 415 chemical examinations have been received from the State Department of Health.

Objectionable microscopic organisms have been present in several of the reservoirs, but not in sufficient numbers to cause objectionable tastes and odors in reservoirs from which the supply was drawn. Lake Cochituate has contained a large growth of Aphanizomenon, which has given the water of that source a disagreeable taste and odor during the greater part of the year.

SANITARY INSPECTION.

The sanitary inspection of the several watersheds has been maintained, and violators of the rules and regulations of the Board have been prosecuted. Nine persons were prosecuted and fined for violations of the regulations relative to fishing and bathing, and others have had their licenses revoked and have been cautioned against further violations of the rules.

The results of the inspection of the watersheds is given in the following tables: —

Summary of Sanitary Inspections on the Wachusett Watershed in 1914.

DISTRICT.	Number of Premises Inspected. ¹	CLASSIFICATION OF CASES INSPECTED.										CONDITION AT END OF YEAR.		WATER SUPPLY.					
		Cesspools dug before 1914.	Cesspools dug during 1914.	Direct Privy Drainage.	Indirect Privy Drainage.	Direct Sink Drainage.	INDIRECT SINK DRAINAGE.		BARN DRAINAGE.		Manufacturing Wastes.	Premises Vacant.	No Drainage.	Drainage carried to Filter-beds.	Satisfactory.	Unsatisfactory.	Premises having Pub-lic Water Supply.	Premises supplied by Private Wells, Cisterns, etc.	Premises on which no Water is used.
							Satisfactory.	Unsatisfactory.	Satisfactory.	Unsatisfactory.									
French Brook,	66	32	7	-	-	-	24	-	26	-	-	4	1	-	66	-	7	57	2
Muddy Brook,	40	15	2	-	-	-	18	-	22	-	-	3	-	1	40	-	-	38	2
Gates Brook,	187	123	10	-	1	-	38	4	52	1	-	10	1	1	183	4	-	179	8
Malden Brook,	33	14	2	-	-	-	15	-	23	-	-	2	1	-	33	-	-	32	1
Chaffin Brook,	201	106	14	-	-	-	65	6	89	-	1	10	1	-	194	7	86	110	5
Asnebumskit Brook,	227	148	10	2	3	15	25	7	50	2	3	16	2	1	202	25	174	44	9
Muschopeage,	91	31	4	-	-	1	42	2	41	1	1	7	1	-	86	5	5	82	4
South Wachusett Brook,	87	34	1	-	-	1	37	-	49	1	-	7	4	-	85	2	-	83	4
Trout Brook,	32	4	1	-	-	-	21	-	25	-	1	2	-	-	31	1	-	30	2
East Wachusett Brook,	211	79	4	-	-	2	98	2	99	2	-	11	3	1	206	5	-	201	10
Stillwater River,	143	54	-	-	-	-	72	2	76	2	-	4	1	1	140	3	-	137	6
Wachusett,	171 ²	70	3	-	-	1	73	2	56	1	-	4	5	90	167	4	-	164	7
French Hill,	34	20	3	-	-	-	9	-	13	-	-	1	-	-	34	-	-	33	1
Totals,	1,523	730	61	2	4	20	537	25	621	10	6	81	20	94	1,467	56	272	1,190	61

¹ On some premises there are two or more cases.

² Not including 166 summer cottages at Wachusett Lakes.

Summary of Sanitary Inspections on the Sudbury and Cochrane Watersheds in 1914.

DISTRICT.	Number of Premises inspected. ¹	CLASSIFICATION OF CASES INSPECTED.											CONDITION AT END OF YEAR.				
		Sewer Connections.	Cesspools dug before 1914.	Cesspools dug during 1914.	Direct Privy Drainage.	Indirect Privy Drainage.	Direct Sink Drainage.	INDIRECT SINK DRAINAGE.		BARN DRAINAGE.		Manufacturing Wastes.	Premises Vacant.	No Drainage.	Drainage carried to Filter-beds.	Satisfactory.	Unsatisfactory.
								Satisfactory.	Unsatisfactory.	Satisfactory.	Unsatisfactory.						
SUDBURY WATERSHED.	309	297	5	1	-	-	-	-	-	18	1	-	9	7	-	309	1
Farm Pond.	90	47	1	-	-	-	-	-	36	1	-	-	6	2	-	89	1
Framingham Reservoir No. 3,	299	231	4	-	-	-	-	-	38	2	-	-	5	12	1	293	6
Stony Brook.	2,000	1,603	250	3	-	-	-	-	100	4	-	-	41	16	1,805	1,965	5
Angle Brook.																	
Framingham Reservoirs Nos. 1 and 2,	329		210	4	-	-	-	-	92	1	-	-	3	6	-	328	1
and Cold Spring Brook.	225		193	2	-	-	-	-	26	3	-	-	7	11	-	222	3
Eastern Sudbury.	414		204	1	-	-	-	-	149	11	3	-	32	14	-	399	15
Indian Brook.	185		95	1	-	-	-	-	62	8	2	-	1	8	-	176	9
Western Sudbury.	113		29	1	-	-	-	-	62	2	2	-	16	4	-	110	3
Whitehall Reservoir.	811	539	162	1	-	-	-	-	71	6	1	-	43	14	-	804	7
Cedar Swamp.																	
COCHRANE WATERSHED.																	
Snake Brook.	194	-	130	10	-	-	-	-	43	1	-	-	9	3	-	193	1
Pagan Brook.	1,034	751	211	3	-	-	-	-	41	-	-	-	30	9	995	1,034	-
Course Brook.	108	2	76	3	-	-	-	-	25	-	-	-	5	2	-	108	-
Beaver Dam Brook.	1,571	1,203	242	15	-	-	-	-	57	5	3	-	56	20	1	1,563	8
Totals.	7,682	4,995	2,085	49	-	8	4	802	44	1,174	19	1	270	129	2,802	7,623	59

¹ On some premises there are two or more cases.

There was a reduction of 57 in the total number of premises on the Wachusett watershed, due to the diversion of 9.35 square miles of the drainage area by the city of Worcester, and there has been a reduction in the number of unsatisfactory cases on each of the watersheds, due to improvements made in the methods of disposing of the household and manufacturing wastes.

Legal measures for the improvement of sanitary conditions in the valley of Gates Brook, near the West Boylston-Worcester line, have been instituted through the office of the Attorney-General, but no definite results have been accomplished as yet.

Surveys have been made and plans prepared for the purpose of improving the sanitary conditions on the Wachusett watershed.

On the Sudbury and Cochituate watersheds the number of premises where the drainage is removed by sewers outside the watershed has been increased by 173, and the number still existing on streets where sewers have been built also shows an increase, due to the fact that houses in the Lokerville district of Framingham, where sewers have been recently constructed, have not yet been connected with the sewers. The number of premises, both connected and unconnected, in the several places was, on December 31, 1914, as follows:—

	PREMISES CONNECTED WITH SEWERS.		PREMISES NOT CONNECTED WITH SEWERS.	
	1913.	1914.	1913.	1914.
Marlborough,	1,589	1,603	45	41
Westborough,	529	539	12	7
Framingham,	1,363	1,491	17	58
Natick,	734	751	25	21
Sherborn,	7	11	—	—
Totals,	4,222	4,395	99	127

There were two cases of typhoid fever reported as occurring on the Wachusett watershed, five cases on the Sudbury watershed and two cases on the Cochituate watershed. In all cases necessary measures were taken to prevent contamination of the water supply.

SWAMP DITCHES AND BROOKS.

The ditches, 36.36 miles in length, which are maintained by the Board on the several watersheds for the purpose of improving the quality of the water, have received the usual care and attention.

They have been cleaned and the weeds and brush alongside the ditches cut and burned for a width of about 20 feet. Repairs have been made to the Deerfoot and other ditches on the Sudbury watershed which have included 1,403 linear feet of new bottom boards, 1,899 feet of side rails and 2,635 square feet of repaving. The ditches in Big Crane Swamp were reshaped and repaved for a distance of 4,679 feet, and 2,925 feet of Clinton electrically welded wire fencing, which was erected in 1899 along the property line of the Board to keep cattle from the drainage ditches, has been replaced with No. 65 Wheelock wire fencing, at a cost of \$598.66.

PROTECTION OF THE SUPPLY BY FILTRATION.

The several filter-beds which are maintained by the Board for the purpose of protecting the water collected in the streams before its admission into the storage reservoirs have been maintained as usual. The Marlborough Brook filter-beds, with an area of 14 acres, received the water from an area of 2 square miles of the thickly settled portion of the city of Marlborough, and filtered all, with the exception of 39,500,000 gallons, which flowed directly into the Sudbury Reservoir between March 1 and 4, at a time when the beds did not have sufficient capacity, owing to their frozen condition, to filter the entire flow of the brook. Early in the spring the bed of the brook which enters these beds was cleaned, and in June and July the receiving basin and the filter-beds were cleaned. From the receiving basin 1,540 cubic yards of material were removed and disposed of as filling on the adjoining land of O. P. Walker, at a cost of 41 cents per cubic yard.

The filter-beds on Farm Street received diluted sewage from the Marlborough main sewer on one day in March, five days in April and one day in May, and a flow of ground water from the sewer at times during March, April, May and July.

At the Pegan Brook pumping station, where the surface drainage from an area of about 1 square mile in the thickly settled portion of the town of Natick is pumped upon filter-beds before entering Lake Cochituate, the pumps were operated during portions of 256 days, and 309,005,000 gallons, equivalent to a daily average of 846,589 gallons, were pumped to the filter-beds. Overflow from Pegan Brook to Lake Cochituate took place at different times between March 1 and 5, and from the intercepting ditch to the lake

on January 24, 25 and 31, also from March 1 to 7. At these times the yield of the brook watershed was larger than could be cared for by the filter-beds in their frozen condition. The amounts unfiltered which ran directly to the lake were about 14,000,000 gallons from Pegan Brook and 37,000,000 gallons from the intercepting ditch. The cost of operating the pumping station, and cleaning and maintaining the filter-beds and settling reservoir was \$4,945.36, equivalent to a cost of \$16 per million gallons treated, which is higher than usual as it includes the cost of removing the sediment which had collected in Pegan Brook, the settling reservoir and the ditches leading thereto during the past several years.

The four filter-beds, with a combined area of 2 acres, on which was received the flow from 525 acres in the village of Sterling, treated the entire flow from the brook.

The filter-beds on which the sewage from the Worcester County Training School is received and treated have been cared for and have operated satisfactorily throughout the year.

The Gates Terrace filter-beds at Sterling Junction were operated from April 18 to November 7.

FORESTRY.

During the year 99,300 white pine seedlings, nearly all of which were 3 years old, were planted in the vicinity of the Sudbury Reservoir and 28,000 seedlings and about 3,600 small pines at other reservoirs and along the Sudbury, Cochituate and Weston aqueducts. Near the Wachusett Dam and along the open channel portion of the Wachusett Aqueduct 2,200 4-year-old white pine seedlings were set out, but other planting in the Wachusett Department was deferred until another season on account of the dry weather.

During the spring there were received from the State Forester 353,400 white pine seedlings which were placed in transplant beds in nurseries near the Sudbury and Wachusett reservoirs. These have been cultivated and the several nurseries contained trees as follows at the end of the year: —

Sudbury Department: —

Sudbury nursery, 135,000 2-year-old white pine seedlings.

Sudbury nursery, 22,500 3-year-old white pine seedlings.

Wachusett Department: —

Oakdale nursery, 149,000 4-year-old white pine seedlings.
 Oakdale nursery, 62,700 3-year-old white pine seedlings.
 Oakdale nursery, 28,300 4-year-old spruce seedlings.
 Oakdale nursery, 200 2-year-old red pine seedlings.
 Oakdale nursery, 200 3-year-old sequoia seedlings.
 North Dike nursery, 122,200 2-year-old white pine seedlings.

Considerable work has been done in preparing land for the planting of pine trees by removing brush and undesirable trees. Thirty acres of land at Boylston, formerly owned by C. L. Lord, was thus prepared.

The work of protecting the chestnut trees from destruction by the chestnut bark disease has been carried on in the Wachusett Department by cutting out 5,660 diseased trees on 1,655 acres of woodland, by clearing all trees from 24 acres where the disease was very prevalent, and by cutting all chestnut trees on an area of 8 acres covered with 20-year-old oak, maple and chestnut. All of this work cost \$3,760, and there was received \$2,040 from the sale of telephone poles, railway ties, chair logs and cord wood.

The following sums have been expended on the several parts of the works in protecting the trees from the ravages of destructive insects: —

Spot Pond,	\$874 40
Mystic Lake, Station and Reservoir,	39 83
Chestnut Hill Reservoir,	492 94
Weston Reservoir and lower portion of Weston Aqueduct,	1,114 23
Sudbury, Cochituate and Weston aqueducts,	506 22
Sudbury Reservoir,	1,120 73
Framingham Reservoirs Nos. 1, 2 and 3, Hopkinton Reservoir and Cedar Swamp,	273 99
Lake Cochituate,	637 17
Wachusett Reservoir: —	
Painting gypsy moth eggs,	1,199 09
Spraying gypsy moths,	651 00
Pine tree weevil (1,313 acres),	437 15
Tent caterpillars,	440 29
	<hr/>
	\$7,787 04

In doing this work about 96,600 clusters of the eggs of the gypsy moth were painted with creosote, and 18,000 pounds of arsenate of lead were used in spraying the foliage of the trees to destroy the caterpillars.

DISTRIBUTING RESERVOIRS.

The water collected and stored in the reservoirs on the several watersheds has been conveyed to and delivered from the following reservoirs and standpipes located in or near the Metropolitan District:—

	Elevation at High Water.	Capacity in Gallons.
Spot Pond, Stoneham and Medford,	183.00	1,791,700,000
Chestnut Hill Reservoir, Brighton district of Boston,	134.00	300,000,000
Weston Reservoir, Weston,	200.00	200,000,000
Fells Reservoir, Stoneham,	271.00	41,400,000
Mystic Reservoir, Medford,	157.00	26,200,000
Fisher Hill Reservoir, Brookline,	251.00	15,500,000
Waban Hill Reservoir, Newton,	264.50	13,500,000
Forbes Hill Reservoir, Quincy,	192.00	5,100,000
Bear Hill Reservoir, Stoneham,	300.00	2,450,000
Arlington Standpipe, Arlington,	442.00	550,000
Forbes Hill Standpipe, Quincy,	251.00	330,000
Total,	—	2,396,730,000

Spot Pond, Fells and Bear Hill Reservoirs.

Spot Pond is the principal distributing reservoir of the Metropolitan Water Works, and a force averaging 10 men has been employed in caring for the reservoir and its surrounding grounds, which form a portion of the Middlesex Fells park reservation, including the Fells and Bear Hill reservoirs, which are located near by. Spot Pond has been in constant use, and with its connected structures and grounds is now in good condition. The cost of patrolling the property of the Board in the vicinity of the Spot Pond, Fells and Bear Hill reservoirs, and in preventing the pollution of the water supply by the public, which frequents the reservoirs in large numbers during pleasant weather, was \$1,263.

Considerable trouble has been experienced and labor expended in keeping the pond free from ducks and gulls, as we are not allowed by the State law to kill the birds and our efforts are directed toward driving them away by the use of a motor boat and blank cartridges, which prove but partially successful. During one week in October 2,840 gulls and 1,515 ducks were reported as present on the pond.

Chestnut Hill Reservoir.

This reservoir has received the water delivered by the Sudbury Aqueduct, and from its Bradlee basin has been drawn the water pumped for the southern high and low service districts. The gate-

houses, walks and grounds have been kept in repair and are in good order, with the exception of the fence on the northerly line of Beacon Street, which should be renewed during the present year. The inspection and patrol work at this reservoir cost \$613.62.

Weston Reservoir.

This reservoir was used continuously throughout the year for storing and delivering the supply received from the Weston Aqueduct. In addition to the ordinary care of the structures and grounds, some work has been done by the maintenance force in constructing foot paths. Three culverts were built over the surface drainage ditch which skirts the north and west sides of the reservoir. One thousand and eighty pines and cedars were planted on the grounds, and a story and a half structure, 18 feet x 26 feet, has been erected near Ash Street for use as a stable and storehouse. This building has sides of cement stucco on metal lath, a floor and partitions of cement concrete, and a roof covered with Reynolds asphaltum shingles. The building, which was erected by the regular employees of the Board, cost \$888.45.

Fisher Hill and Waban Hill Reservoirs.

These reservoirs, which receive and from which is distributed the water pumped at Chestnut Hill for the supply of the southern high-service district, have been kept in repair by the force which also cares for Chestnut Hill Reservoir. The resurfacing of the path around the Waban Hill Reservoir with crushed stone obtained from the supply pipe line tunnel has been partially completed. Considerable labor has been expended in trimming the trees and shrubbery on the grounds at Fisher Hill Reservoir, which was acquired from the city of Boston by this Board in 1913.

Miscellaneous Structures.

The Forbes Hill Reservoir and water tower are in good condition, as well as the Mystic Reservoir and the standpipe in Arlington. Mystic Lake has not been used as a source of water supply for the District since 1898, but the dam, aqueduct and other structures are cared for by this Board. The apron below the outlet dam at Mystic Lake has been repaired during the past year at an expense of \$429.97.

PIPE LINES.

The length of mains owned and operated by the Board has been increased 2.95 miles during the year, as a result of laying new mains for a length of 3.32 miles in Boston, Cambridge, Chelsea, Milton and Quincy, and of discontinuing old mains for a length of 0.37 of a mile in Boston, Cambridge and Chelsea. The length controlled and operated by the Board on December 31, 1914, was 119.05 miles, and the length of mains 4 inches in diameter and larger connected with the works but owned and operated by the several cities and towns supplied with water was 1,694.90 miles.

Relaying 24-inch Main on Broadway, Chelsea.

The 24-inch water pipe in Broadway, Chelsea, was relaid for a distance of 1,379.4 feet in 1913. The surface of the trench in which the pipe was laid has been repaved during the past year by C. W. Dolloff & Company. The cost of the work, including labor and materials furnished by the Commonwealth, was \$1,789.28. This added to the cost of work done in 1913 makes the total cost of relaying 1,379.4 feet of 24-inch pipe \$9,174.02.

Cleaning 24-inch Pipe Line.

A section of the easterly 24-inch pipe line at Chelsea Creek, in East Boston, was cleaned in September for a length of 612 feet by the National Pipe Cleaning Company, in order to demonstrate the efficiency of its methods.

Anderson Bridge.

The laying of pipes on the new Anderson Bridge over the Charles River to replace the submerged pipes with flexible joints, which had been injured by electrolytic action since they were laid in 1897, was begun in 1913 and completed May 25. The pipe line as relaid is divided on each side of the river by a 48-inch x 36-inch Y branch, and crosses over the bridge by two lines of pipe each about 420 feet long, laid in the sidewalk. By reason of the shallow depth of filling over the masonry arches the size of the pipes crossing the bridge was reduced from 36 inches to 30 inches for a distance of 227 feet. The amount expended for this work in 1913 was \$4,951.49, and in 1914, \$6,392.78, making a total of \$11,344.27.

Connection with Lynn.

A connection 12 inches in diameter has been made between the 16-inch Metropolitan main and a 12-inch main of the city of Lynn, at the corner of Broad and Washington streets in Lynn, for the use of the city of Lynn or this Board in case of emergency.

Pipe Bridge over Boston & Albany Railroad.

The plate girder bridge, built by the Boston Bridge Works for the city of Boston in 1894, and used for supporting the 36-inch pipe over the Boston & Albany Railroad at Chestnut Hill Avenue, Brookline, was found to be seriously deteriorated by the action of gases and blast from the locomotives passing below. Damaged portions of the bridge were renewed and the girders strengthened by the Boston Bridge Works at a cost of \$531.09.

Breaks and Leaks.

About 10.15 A.M. on October 3 a 36-inch pipe in one of the two lines into which the 48-inch pipe line is divided where it passes under the Mystic River at Wellington Bridge, Somerville, was broken by the accidental dropping on it of an 18-inch square steel-pointed spud connected with a dredging machine belonging to the Eastern Dredging Company. As a result the water flowed from the openings at an average rate of about 75,000,000 gallons per day while the gates for controlling the flow of water were being closed, and the pressure over the northern low service district was lowered from 25 to 35 pounds below normal for about 45 minutes. This line was repaired by removing the broken pipe which necessitated blasting with dynamite, inserting two new lengths of 36-inch pipe with the aid of a diver, and making the joints with lead wool. The approximate cost of the work, which was done by and at the expense of the Eastern Dredging Company under the supervision of this department, was \$800.

Other leaks which have been repaired by and at the expense of the department have numbered 63, and have entailed an expense of \$3,257.54.

The most expensive leaks were the replacing of a cracked 36-inch curve at the Chestnut Hill high-service station, which cost \$468.47; repairing two 36-inch joint leaks under the Malden River, \$413.31; repairing two leaks in lead joints under the Mystic River,

\$700, and repairing two 48-inch joint leaks under the tracks of the Boston & Albany Railroad at the Longwood Station, which cost \$610.50.

The sum of \$959.02 was spent for labor and materials used in restoring the estates damaged by the break in the 48-inch main on Clinton Road, Brookline, which occurred December 4, 1913. This sum was expended in reloaming and reseeding the damaged properties, cleaning and whitewashing the basements of the houses and relaying the entrance walks.

For the purpose of avoiding breaks in the 48-inch pipe line which passes through Clinton Road, the earth covering over the pipe has been reduced by the removal of about 1,500 cubic yards of earth along a distance of 550 feet, where the pipe passes through a location owned by the Board. This work cost \$1,466.23.

METERING OF WATER TO MUNICIPALITIES.

There are now 76 Venturi meters used in connection with the Metropolitan Water Works. Nine of these are located on the Wachusett and Sudbury supply works, and the remainder are used in the Distribution Department in metering the water supplied to the several municipalities. There are also connected with the works three Hersey disc meters, one Hersey torrent and five Hersey detector meters. These are used to measure flows which are too small to be conveniently measured with a Venturi meter.

RECORDING PRESSURE GAGES.

Twenty-two gages have been maintained for the purpose of continuously indicating and recording the pressure in the Metropolitan mains at different points on the works. The average results of these observations are given in Table 44 in Appendix No. 2, and indicate that in general the pressure throughout the system has been well maintained and at some points increased as compared with the records of previous years.

ELECTROLYSIS.

Electric potential and current measurements to determine the probable extent of electrolytic action upon the water mains were made during the year in the portion of the district north of the Charles River.

The results of the measurements show an improvement over the former conditions by a reduction of about 50 per cent. in the current returning over the water mains to the street railway power station in Chelsea and by a noticeable reduction in the current returning over the water mains to the street railway power station in Lynn.

The improved condition in Chelsea is probably due in part to the use of insulating joints in relaying the 24-inch water main in Broadway in 1913 and in part to a rearrangement and increase in capacity of the street railway return feeders, made by the railway company during the same year.

The improved condition in Lynn is probably due to the installation of insulating joints in the 16-inch water main at Fox Hill Bridge in 1913 and to the improvement in the street railway return feeders which has also been made by the railway company.

The operation of a new substation located on Center Street in Malden since 1912 has probably had some effect in reducing the electric current flowing on the water mains leading to Chelsea. The operation of this substation has, however, produced a positive area of small extent in the water mains in the vicinity.

The practice of making insulating joints at intervals of about 500 feet in all new pipe lines laid has been continued during the year, and considerable benefit is probably derived from the work.

CLINTON SEWAGE DISPOSAL WORKS.

The Clinton sewage disposal works were operated daily throughout the year. The daily average quantity of sewage pumped to the filter-beds was 1,022,000 gallons, which is about an average for the past three years. During the months of April and May, when large quantities of water were flowing in the Nashua River, the quantities of sewage pumped were excessive, due, largely, to the leaky condition of the sewer paralleling the Nashua River through German-town, where the water from the river enters the sewer at times of high water. The daily average quantity of sewage pumped during each month of the year was as follows: —

	Gallons.
January,	920,000
February,	1,044,000
March,	1,307,000
April,	1,888,000
May,	1,660,000
June,	911,000
July,	798,000
August,	773,000
September,	742,000
October,	711,000
November,	723,000
December,	792,000

Pumping Station.

The following are statistics relating to the operation of the pumping station: —

Daily average quantity of sewage pumped (gallons),	1,022,000
Daily average quantity of energy consumed (kilowatt hours),	321
Daily average quantity of coal consumed in burning sludge and heating building (pounds),	274
Gallons pumped per kilowatt hour,	3,174
Daily average lift of sewage (feet),	49.3
Daily average efficiency of pumping unit (per cent.),	55.3
Number of days pumping,	365
Cost of pumping: —	
Labor,	\$1,296 34
Energy (at \$5.30 per thousand kilowatt hours),	621 58
Fuel (coal for burning sludge and heating),	232 04
Repairs and supplies,	221 46
Total for station,	\$2,371 42
Cost per million gallons pumped,	\$6.36
Cost per million gallons raised 1 foot high, . . . . .	.13

The woodwork of the station, both outside and inside, has been painted and minor repairs made to windows, doors and roof so that the building is now in good repair.

Filter-beds.

Sewage was applied to the filter-beds in practically the same manner as during the preceding $6\frac{1}{2}$ years. Each of the 25 1-acre beds has received about 71,000 gallons of sewage in 30 minutes at

intervals of 1.7 days, equivalent to about 41,000 gallons per acre per day. During the winter season the surface of the beds was plowed in furrows about 3½ feet apart. The settling basins, into which the sewage is pumped previous to being applied upon the filter-beds, were in continuous use throughout the year. Seven hundred and twenty-five cubic yards of sludge were collected from these basins, of which quantity 500 yards have been spread on six acres of grass land near the filter-beds and one acre at the pumping station, and the remainder stored near the filtration area. Concrete carriers were constructed upon filter-beds Nos. 28 and 29. The following tabulation shows the results of the analyses of the sewage and effluent for the past year as compared with those for previous years:—

[Parts per 100,000.]							
	Average of Four Years, 1907-10.	1911.	1912.	1913.	1914.		Whole Year, 1914.
					Janu- ary to June.	July to Decem- ber.	
Albuminoid ammonia, sewage,	1.1444	1.0683	1.6017	1.2025	1.1317	1.6233	1.3775
Albuminoid ammonia, effluent,	.0605	.0639	.0724	.0369	.1121	.0396	.0758
Per cent. removed,	94	94	95	97	90	98	94
Oxygen consumed, sewage,	9.279	9.3292	11.812	9.317	9.3500	12.3000	10.825
Oxygen consumed, effluent,	.6943	.8713	.5170	.5037	.7138	.4434	.5786
Per cent. removed,	92	91	95.5	95	92	96	94.5
Free ammonia, sewage,	4.5374	5.7417	4.2129	4.3083	3.8833	4.4483	4.1658
Free ammonia, effluent, . . . . .	.5591	.7369	.6709	.1792	.5620	.1070	.3345
Per cent. removed,	88	87	84	96	86	98	92
Nitrogen as nitrates, effluent,	1.0564	.9740	.8638	1.6542	.6138	1.4980	1.0559
Iron, effluent, . . . . .	.4018	.5203	.3779	.0696	.1298	.0306	.0802

The cost of maintaining the filter-beds has been as follows, including the cost of constructing concrete carriers on two beds:—

Labor,	\$4,383 40
Supplies and expenses,	194 51
	<hr/>
	\$4,577 91
Cost per million gallons treated,	\$12 28

HYDRO-ELECTRIC POWER STATION.

The hydro-electric power station at the Wachusett Dam was operated on 286 days during the year. The daily output has varied from the minimum amount which the Connecticut River Transmission Company is required to take under its contract to the full capacity of the plant. The following are the statistics relative to the operation of the station: —

Quantity of energy sold to Connecticut River Transmission Company (kilowatt hours),	7,033,457
Quantity of energy used at power station (kilowatt hours),	14,393
Quantity of energy used at Sewerage Pumping Station (kilowatt hours),	117,280
	<hr/>
Total quantity of energy generated (kilowatt hours),	7,165,130

Quantity of water used (gallons),	33,270,900,000
Average effective head (feet),	90.9
Kilowatt hours generated per million foot gallons,	2.369
Efficiency of station (per cent.),	75.4

Earnings: —

Energy supplied Connecticut River Transmission Company at \$5.30 per thousand kilowatt hours,	\$37,277 32
Labor supplied Connecticut River Transmission Company,	29 50
Energy supplied power and sewerage pumping stations, credited at \$5.30 per thousand kilowatt hours,	697 87
	<hr/>
	\$38,004 69

Cost of operating station: —

Labor,	\$5,311 65
Fuel for heating building,	90 00
Repairs and appliances,	157 83
Oil and waste,	83 03
Small supplies,	239 45
Taxes,	3,087 50
	<hr/>
	8,969 46

Net earnings,	\$29,035 23
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Net earnings per thousand kilowatt hours generated,	\$4.052
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ENGINEERING.

In addition to the supervision of work already described the engineering force has had charge of miscellaneous work as follows:—

In connection with the location of possible sources of pollution a survey has been made and plans prepared of about 75 per cent. of the premises on the Wachusett watershed.

A survey of all property owned by the Board in Cedar Swamp and along the Sudbury River from Westborough to Framingham Reservoir No. 2 has been completed and plans of the same are now nearly finished. A survey has also been made of all land lines around Ashland Reservoir and in the swamp at the head of Hopkinton Reservoir.

In compliance with chapter 50 of the Resolves of 1914, a special report has been prepared and an estimate made of the cost of putting Spot Pond Brook in such condition that it will properly receive and carry off the water which may flow into it under ordinary circumstances.

Appended to this report are tables giving the amount of work done and other information relative to contracts, a series of tables relating to the maintenance of the Metropolitan Water Works, including the rainfall, yield of sources of supply, consumption of water in the different districts, the number of service pipes, meters and fire hydrants in the Metropolitan Water District, and a summary of statistics for the year 1914.

Respectfully submitted,

DEXTER BRACKETT,

Chief Engineer.

Boston, January 1, 1915.

REPORT OF ENGINEER OF SEWERAGE WORKS.

To the Metropolitan Water and Sewerage Board.

GENTLEMEN: — The following report of the operations of the Metropolitan Sewerage Works for the year ending December 31, 1914, is respectfully submitted: —

ORGANIZATION.

The Engineer has charge of the design and construction of all new works, and of the maintenance and operation of all the works controlled by the Metropolitan Water and Sewerage Board for removing sewage from the twenty-four municipalities which comprise the Metropolitan Sewerage Districts.

The Engineer has had the following assistants: —

HENRY T. STIFF,	. . . . .	<i>Division Engineer, in charge of office and drafting room, of construction of the new Mystic sewer, North Metropolitan System, and of the relief outfall, High-level sewer at Nut Island.</i>
CLARENCE A. MOORE,	. . . . .	<i>Assistant Engineer, in charge of maintenance studies and records.</i>
ARTHUR F. F. HASKELL,	. . . . .	<i>Assistant Engineer, in charge of survey work and field work in connection with the new Mystic sewer construction and with the relief outfall, High-level sewer at Nut Island.</i>

In addition to the above, the average number of engineering and other assistants employed during the year was 13, which includes 1 instrumentman, 5 inspectors, 2 draftsmen, 3 rodmen and engineering assistants and 2 stenographers.

METROPOLITAN SEWERAGE DISTRICTS.

AREAS AND POPULATIONS.

During the year no changes have been made in the extent of the sewerage districts as given in the last annual report.

The populations of the districts, as given in the following table, are based on the census of 1910.

Table showing Areas and Estimated Populations within the Metropolitan Sewerage Districts, as of December 31, 1914.

CITY OR TOWN.		Area (Square Miles).	Estimated Population.
North Metropolitan District.	Arlington,	5.20	13,180
	Belmont,	4.66	6,680
	Boston (portions of),	3.45	110,490
	Cambridge,	6.11	111,500
	Chelsea,	2.24	37,450
	Everett,	3.34	39,100
	Lexington, ¹	5.11	4,520
	Malden,	5.07	49,480
	Medford,	8.35	26,810
	Melrose,	3.73	17,060
	Revere,	5.86	21,830
	Somerville,	3.96	85,390
	Stonham,	5.50	8,180
	Wakefield,	7.65	12,490
South Metropolitan District.	Winchester,	5.95	10,380
	Winthrop,	1.61	12,010
	Woburn,	12.71	16,380
		90.50	582,930
	Boston (portions of),	24.96	228,850
	Brookline,	6.81	31,600
	Dedham, ¹	9.40	9,860
	Milton,	12.59	8,720
	Newton,	16.88	44,040
	Quincy,	12.56	36,860
	Waltham,	13.63	30,690
	Watertown,	4.04	14,620
Totals,		191.37	988,170

¹ Part of town.

METROPOLITAN SEWERS.

SEWERS PURCHASED AND CONSTRUCTED AND THEIR CONNECTIONS.

During the year there have been built 1.249 miles of Metropolitan sewer within the sewerage districts, so that there are now 107.135 miles of Metropolitan sewers. Of this total, 9.642 miles of sewers, with the Quincy pumping station, have been purchased from cities and towns of the districts, the remaining 97.493 miles of sewers and other works having been constructed by the Metropolitan boards.

The locations, lengths and sizes of these sewers are given in the following tables, together with other data referring to the public and special connections with the systems:—

NORTH METROPOLITAN SEWERAGE SYSTEM.

Location, Length and Sizes of Sewers, with Public and Special Connections.

CITY OR TOWN.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1914.	SPECIAL CONNECTIONS.	
				Character or Location of Connection.	Number in Operation.
Boston:—					
Deer Island,	6' 3" to 9' 0",	1.367	4	Shoe factory,	1
East Boston,	9' 0" to 1' 0",	5.467	25	Middlebrook Wool-combing Co.,	1
Charlestown,	6' 7"×7' 5" to 1' 0", . .	3.292	14	Navy Yard,	8
Winthrop,	9' 0",	2.864	13	Almshouse,	1
Chelsea,	8' 4"×9' 2" to 1' 10"×2' 4", .	5.230	13	Private building,	1
				Club house,	1
				Fire Department Station,	1
				Private building,	1
				Bakery,	1
				Rendering works,	1
				Metropolitan Water Works blow-off,	1
				Chelsea Water Works blow-off, . .	2
				Metropolitan Water Works blow-off, . .	1
Everett,	8' 2"×8' 10" to 4' 8"×5' 1", .	2.925	7	Cameron Appliance Co.,	1
				Shultz-Goodwin Co.,	1
				Andrews-Wasgatt Co.,	1
				National Metallic Bed Co.,	1
				Linoide Co.,	1
				Factory,	1
				New England Structural Co., . . .	1
Malden,	4' 6"×4' 10" to 1' 0", . . .	5.844 ¹	33	Metropolitan Water Works blow-off, . .	1
				Private buildings,	169
				Private buildings,	113
Melrose,	4' 6"×4' 10" to 10",	6.099 ²	36	Factory,	1
				Railroad station,	1
				Park Department bath house, . . .	1
				Harvard dormitories,	2
Cambridge,	5' 2"×5' 9" to 1' 3",	7.209	40	Slaughterhouse,	1
				City Hospital,	3
				Street railway machine shop, . . .	1
				Tannery,	1
				Slaughterhouses (3),	1
				Car-house,	1
Somerville,	6' 5"×7' 2" to 10",	3.577	11	Somerville Water Works blow-off, . .	1
				Street railway power house, . . .	1
				Stable,	1
				Rendering works,	1
				Railroad scale pit,	1
Medford,	4' 8"×5' 1" to 10",	5.713	23	Armory building,	1
				Private buildings,	8
				Stable,	1
				Police substation,	1
				Tannery,	4
Winchester,	4' 6" to 1' 3",	9.470	19	Private buildings,	4
				Gelatine factory,	1
				Stable,	1
				Railroad station,	1
				Felt works,	1
Stoneham,	1' 3" to 10",	0.010	4	Glue factory,	1
Woburn,	1' 10"×2' 4" to 1' 3", . . .	0.933	3	Private buildings,	145
Arlington,	1' 6" to 10",	3.520 ³	38	Railroad station,	1
				Car-house,	3
				Post office,	1

¹ Includes 1.84 miles of sewer purchased from the city of Malden.² Includes .736 of a mile of sewer purchased from the city of Melrose.³ Includes 2.631 miles of sewer purchased from the town of Arlington.

Location, Length and Sizes of Sewers with Public and Special Connections
— Concluded.

CITY OR TOWN.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1914.	SPECIAL CONNECTIONS.	
				Character or Location of Connection.	Number in Operation.
Belmont, ¹	—	—	—	—	—
Wakefield, ¹	—	—	—	—	—
Revere, . . .	4' 0" to 3' 0", . . .	0.136	2	—	—
		63.656 ²	289		503

¹ The Metropolitan sewer extends but a few feet into the towns of Belmont and Wakefield.

² Includes 2.787 miles of Mystic valley sewer in Medford, Winchester and Woburn, running parallel with the Metropolitan sewer.

SOUTH METROPOLITAN SEWERAGE SYSTEM.

Location, Length and Sizes of Sewers, with Public and Special Connections.

CITY OR TOWN.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1914.	SPECIAL CONNECTIONS.	
				Character or Location of Connection.	Number in Operation.
Boston: —					
Back Bay, . . .	6' 6" to 3' 9", . . .	1.500 ¹	15	Tufts Medical School, . . .	1
				Private house, . . .	1
				Administration Building, . . .	1
				Boston Park Department, . . .	1
				Simmons College buildings, . . .	1
				Art Museum, . . .	2
Brighton, . . .	5' 9"×6' 0" to 12", . . .	6.010 ²	14	Abattoir, . . .	3
				Chocolate works, . . .	2
				Machine shop, . . .	1
Dorchester, . . .	3'×4' to 2' 6"×2' 7", . . .	2.870 ³	13	Paper mill, . . .	1
				Private buildings, . . .	3
				Edison Electric Company Station, . . .	1
Hyde Park, . . .	10' 7"×11' 7" to 4' 0"×4' 1", . . .	4.527	17	Mattapan Paper Mills, . . .	1
Roxbury, . . .	6' 6"×7' to 4' 0", . . .	1.430	—	Private buildings, . . .	2
West Roxbury, . . .	9' 3"×10' 2" to 12", . . .	7.600	13	—	—
Brookline, . . .	6' 6"×7' 0" to 8", . . .	2.540 ⁴	12	Parental School, . . .	1
Dedham, . . .	4'×4' 1" to 3' 9"×3' 10", . . .	2.350	7	Lutheran Evangelical Church, . . .	1
Hull, . . .	60" pipe, . . .	0.750	—	Private buildings, . . .	4
Milton, . . .	11'×12' to 8", . . .	3.600	21	Private building, . . .	1
Newton, . . .	4' 2"×4' 9" to 1' 3", . . .	2.911	6	—	—
Quincy, . . .	11' 3"×12' 6" to 24" pipe, . . .	6.640	14	Private buildings, . . .	2
Waltham, . . .	3' 6"×4' 0", . . .	0.001	1	Private houses, . . .	6
Watertown, . . .	4' 2"×4' 9" to 12", . . .	0.750 ⁵	5	Metropolitan Water Works blow-off, . . .	1
				—	—
				Factories, . . .	2
				Stanley Motor Carriage Co., . . .	1
				Knights of Pythias building, . . .	1
		43.479	138		40

¹ Includes .355 of a mile of sewer purchased from the city of Boston.

² Includes .446 of a mile of pipe and concrete sewers built for the use of the city of Boston; also .026 of a mile of sewer purchased from the town of Watertown.

³ Includes 1.24 miles of sewer purchased from the city of Boston.

⁴ Includes .158 of a mile of pipe sewer built for the use of the town of Brookline.

⁵ Includes .025 of a mile of sewer purchased from the town of Watertown.

Information relating to areas, populations, local sewer connections and other data for the whole Metropolitan Sewerage District appears in the following table: —

North Metropolitan District.

Area (Square Miles).	Estimated Total Population.	Miles of Local Sewer connected.	Estimated Population contributing Sewage.	Ratio of Contributing Population to Total Population (Per Cent.).	CONNECTIONS MADE WITH METRO- POLITAN SEWERS.	
					Public.	Special.
90.50	582,930	728.73	524,330	89.9	289	503

South Metropolitan District.

100.87	405,240	610.03	275,310	67.9	138	40
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Entire Metropolitan District.

191.37	988,170	1,338.76	799,640	80.9	427	543
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Of the estimated gross population of 988,170 on December 31, 1914, 799,640, representing 80.9 per cent., were on that date contributing sewage to the Metropolitan sewers, through a total length of 1,338.76 miles of local sewers owned by the individual cities and towns of the district.

These sewers are connected with the Metropolitan System by 427 public and 543 special connections. During the current year there has been an increase of 31 miles of local sewers connected with the Metropolitan System, and 13 public and 11 special connections have been added.

CONSTRUCTION.

NORTH METROPOLITAN SEWERAGE SYSTEM.

SECTION 69 — NEW MYSTIC SEWER. — NORTH METROPOLITAN SYSTEM.

As noted in last year's report this section was divided into two contracts. The particulars of this section and contracts are as follows: —

Date of contract No. 110, January 2, 1914.

Length of section covered by this contract, 2,300 feet.

Name of contractor, Henry Spinach Contracting Co.

Average depth of cut, 10 feet.

Diameter of circular concrete sewer, 42 inches.

Division Engineer in charge of construction, Henry T. Stiff.

Assistant Engineer, A. F. F. Haskell.

This contract covered that portion of Section 69 extending from the southerly side of Mt. Vernon Street, Winchester, through private land of David N. Skillings, then through land of the town of Winchester, then in a private way to other land of said town, then through said town land and private lands of John S. Lynam and Antonio Piluso and extending a short distance in the location of the Boston & Maine Railroad to sewer Station 23 + 00 near Judkins Pond.

Owing to severity of weather, work was not started on this contract until about March 1, 1914. No excavating machinery was used. Pile foundation was placed from Station 8 + 05 to Station 14 + 20 and from Station 15 + 95 to Station 18 + 43. No large amount of ground water was found except at about Station 5 + 50, where an 8-inch centrifugal pump was used. Work under this contract was completed November 7, 1914.

The remainder of the section was let as Contract No. 111 and extended from Station 23 + 0 to Station 49 + 69. Some particulars of this portion and contract are as follows:—

Date of contract No. 111, January 2, 1914.

Length of portion covered by this contract, 2,669 feet.

Name of contractor, Henry Spinach Contracting Co.

Average depth of cut, 20 feet.

Diameter of circular concrete sewer, 36 inches.

Division Engineer in charge of construction, Henry T. Stiff.

Assistant Engineer, A. F. F. Haskell.

This contract covered that portion of Section 69 which extends northward from a point in the location of the Boston & Maine Railroad near Judkins Pond, through the location of said road on a centre line 10 feet from the easterly side of said railroad land for a distance of 2,350 feet, then turns to westward and crosses under the tracks of said railroad, then under Aberjona River, then across Section 45 of Metropolitan sewer built in 1893, to a point in land of said railroad which is the beginning of Section 70, new Mystic sewer, a total length of 2,669 feet.

From Station 23 + 00 to Station 46 + 00 the sewer was built in fine sand which contained a small amount of water. Owing to the

excessively dry season this section of sewer was constructed without difficulty. At Station 46 + 00 the material changed to sand and gravel, and a trench excavating machine was used.

The crossing of the Aberjona River was effected by means of two lines of 20-inch cast-iron pipe surrounded by concrete laid on grade of sewer. A concrete head house was constructed at either end of the crossing with facilities for controlling the flow in the pipes. From Station 48 + 67 to Station 49 + 63 pile foundation was placed.

At the crossing of Section 45 of the Metropolitan sewer constructed in 1893 a special controlling manhole was built so that sewage from Woburn and Stoneham can be turned through either the old Metropolitan sewer or the new Mystic sewer.

By arrangement between the Railroad Company and the Contractor the surface over the sewer from about Station 27 to about Station 46 was left at a considerably lower elevation than it was formerly. Work under this contract was completed December 19, 1914.

SECTION 70. — NEW MYSTIC SEWER. — NORTH METROPOLITAN SYSTEM.

This section was placed under contract in 1913 and a general statement regarding it is in the report of that year. About 300 feet remained to be constructed on January 1, 1914. This work was finished May 4, 1914.

SECTION 57A. — NORTH METROPOLITAN SYSTEM.

Chapter 259 of the Acts of 1914 directed the Metropolitan Water and Sewerage Board to construct a branch Metropolitan sewer to receive sewage from the southwestern part of the town of Revere. This Act, which was passed at the request of Revere, provided that the cost of construction of this branch sewer should be assessed upon the town.

The section of sewer built under this Act extends in Chelsea and Revere from Station 29 + 42 of Section 57, North Metropolitan Sewerage System, northerly through lands of H. W. Pratt, Edward E. Mills and Elizabeth Clark to a point in Fenno Street in Revere near the Chelsea and Revere boundary and consists of a 15-inch Akron pipe surrounded by Portland concrete built in firm clay ground. Some particulars of this section and contract are as follows: —

Date of contract, May 12, 1914.
Length of section, 1,032 feet.
Name of contractor, G. M. Bryne Co.
Average depth of cut, 6 feet.
Diameter of pipe sewer, 15 inches.
Division Engineer in charge of construction, H. T. Stiff.
Assistant Engineer, C. A. Moore.

This contract was completed July 10, 1914.

DEER ISLAND OUTFALL EXTENSION.

Chapter 344 of the Acts of 1914 directed the Metropolitan Water and Sewerage Board to extend the existing Deer Island outfall. This Act was passed so late in the season that the necessary permits from the United States Government and the Directors of the Port of Boston could not be secured in time to warrant the placing of this work under contract this year.

The nature and location of this work are such that it can be carried on only in a few months of the year. Studies have been made and plans prepared ready for placing the same under contract early in the coming year. •

SOUTH METROPOLITAN SEWERAGE SYSTEM.

SECTION 43. — RELIEF OUTFALL. — NUT ISLAND.

At the time of constructing the High-level sewer only two 60-inch cast-iron outfall lines of the proposed five lines were constructed. These had been able satisfactorily to discharge the flow until the flood period of the winter of 1913 and 1914. During some of the storms the sewage rose to such an elevation in the sewer as to indicate the necessity of at once furnishing additional outfall capacity.

A study was made for an additional line of 60-inch cast-iron pipe to extend about 1,200 feet into tide water to a point where the channel has a depth of 20 feet at low water. Contracts were prepared of which the particulars are as follows: —

Contract No. 113 for 60-inch cast-iron pipe: —

Date of contract, July 15, 1914.
Material, 60-inch cast-iron pipe and specials, 724 tons.
Name of contractor, Camden Iron Works.

Contract No. 120 for placing 60-inch outfall pipe in position: —

Date of contract, August 29, 1914.

Length of section covered by contract, 1,400 feet.

Name of contractor, W. H. Ellis & Son Co.

Division Engineer in charge, H. T. Stiff.

Assistant Engineer, A. F. F. Haskell.

This line is the most westerly of the five lines originally proposed. The contract provides for a pile foundation in that portion extending under the bed of the harbor and a concrete reinforcement around that part constructed on shore with special reinforcements at the outfall.

At this time the outfall curve has been placed, about 800 feet of trench has been dredged and about 96 feet of pipe has been placed in the dredged trench. About 200 feet of pipe has also been laid from Nut Island screen-house to near low water line. To control the flow in this new outfall line a 60-inch Coffin Valve Company sluice gate operated by hydraulic force was purchased and placed in the station by day labor.

24-INCH BRICK SIPHON CROSSING. — SECTION 70. — HIGH-LEVEL SEWER.

In extending its sewerage system, the city of Boston was obliged to cross Section 70 of the High-level sewer at Washington Street, West Roxbury. At this place the Metropolitan sewer is built through very fine sand carrying much water. It was felt that construction under this main trunk sewer in such ground was difficult and somewhat dangerous and arrangements were made whereby the Metropolitan Water and Sewerage Board agreed to assume the risk and do the construction on condition that the city of Boston should reimburse it for the cost. Contract and plans were made and bids for construction by compressed air process were solicited. Following are particulars of the contract as made: —

Date of contract No. 122, November 21, 1914.

Length of 24-inch brick siphon structure, 42 feet.

Lump sum bid, \$4,500.

Name of contractor, Charles A. Haskin.

Division Engineer in charge of construction, H. T. Stiff.

Assistant Engineer, C. A. Moore.

At the present time the contract is completed excepting a small amount of brickwork in one manhole and some backfilling. The work was done without any injury to the Metropolitan sewer.

MAINTENANCE.

SCOPE OF WORK AND FORCE EMPLOYED.

The maintenance of the Metropolitan Sewerage System includes the operation of 7 pumping stations, the Nut Island screen-house and 107.135 miles of Metropolitan sewers, receiving the discharge from 1,338.76 miles of town and city sewers at 427 points, together with the care and study of inverted siphons under streams and in the harbor.

The permanent maintenance force includes 165 men, of whom 101 are employed on the North System and 64 on the South System. These are subdivided as follows: engineers and other employees at the pumping stations, North Metropolitan System, 62; and on maintenance, care of sewer lines, buildings and grounds, 39 men, including foremen; South Metropolitan System, 34 engineers and other employees within the pumping stations; and 30 men, including foremen, on maintenance, care of sewer lines, buildings and grounds.

The regular work of this department, in addition to the operation of the pumping stations, has consisted of routine work of cleaning and inspecting sewers and siphons, caring for tide gates, regulators and overflows, measuring flow in sewers, inspection of connections with the Metropolitan sewers, care of pumping stations and other buildings and grounds, and the maintenance of the ferry at Shirley Gut for transporting employees and supplies in connection with the operation of the Deer Island pumping station.

In addition to these regular duties other work has been done by this department as follows: —

DEER ISLAND PUMPING STATION AND DWELLING.

The four-tenement dwelling house at Deer Island for use of employees in the station has been painted outside during the year.

The wharf built in 1892 and the coal run built in 1895 are in poor condition and considerable repairs have been necessary during the year.

All work was done by maintenance employees.

EAST BOSTON PUMPING STATION.

On June 1, 1914, at about 10.20 A.M. a violent explosion occurred in the old screen-house chamber which entirely destroyed the screen building and caused the death of six men and severe injury to two others. At the time workmen were engaged in washing the sewer walls preparatory to making changes in the channels necessary to the introduction of new screening machinery.

The sewage in the suction sewer had been pumped down several feet below normal elevation and the odor of gasoline was noticeable. Incandescent electric light was being used in the chamber. No other known source of possible ignition was present. No damage was done to the underground structures or passages. The windows, doors and skylights of the main pumping station building were damaged. No interruption of pumping service occurred and only slight damage to one engine (No. 1) was done.

Contracts for repairs occasioned by the explosion were made with the following parties: Contract No. 118 under date of July 24, 1914, with the S. H. Pomeroy Company, Incorporated, provided for repairs to windows and doors. This contract was completed December 11, 1914. Contract No. 119 under date of July 25, 1914, with E. Van Noorden & Company, provided for repairs to skylights. This contract was completed August 21, 1914. Contract No. 121 under date of October 1, 1914, with the J. Caddigan Company, provided for the construction of a new screen building.

The new screen building, 39' x 48', referred to above, consists of the superstructure only of a brick building trimmed with Deer Island granite with concrete roof similar in all respects to the main pumping station building. All foundations were placed by the maintenance force.

The new building is considerably larger than the former one, being carried out about ten feet nearer to the railroad location on the west. A system of forced ventilation has been installed to protect the sewer channels and chambers from the accumulation of dangerous gases.

At the present time the building is constructed to the elevation of the roof girders and the latter are in place ready to receive the concrete roof.

CHARLESTOWN PUMPING STATION.

Extensive repairs have been made on pumping engine No. 1. For several years this pump has been run only in times of emergency, as it was less economical in operation than the other pumps. Changes made in the elevation of the impeller wheel have increased the capacity from a maximum rate of 34,000,000 to a maximum rate of 42,000,000 gallons per 24 hours. This work was done by maintenance mechanics.

MALDEN RIVER SIPHON.

The action of frost had badly damaged the riprap slopes at the head houses of the Malden River siphon. During the year these have been relaid and repaired, the work being done by the maintenance force.

NUT ISLAND STATION.

A reinforced concrete fence has been constructed from a point near the wharf on Nut Island along the eastern side of the roadway over the bar to the mainland, a distance of about 1,400 feet. This was done by the maintenance force.

DRAINAGE FROM TANNERIES, GELATINE AND GLUE WORKS IN WINCHESTER, WOBURN AND STONEHAM.

Five men and a foreman have been employed during a part of the year in flushing and cleaning the Metropolitan sewer through the tannery districts of Winchester, Woburn and Stoneham.

All the tanneries and glue works of the district now have settling tanks of substantial size. This method of treatment has very greatly reduced the amount of sludge material entering the Metropolitan sewers and has materially lessened the cost of maintenance of the sewers in this district.

The following table gives details of settling tanks introduced to date, showing the operations of same with the amount of sludge collected and removed: —

Table of Semi-fluid Sludge removed from Settling Basins at the Tanneries, Gelatine and Glue Works in Winchester, Woburn and Stoneham.

LOCATION OF BASIN.	Basin put in Operation.	Inside Measurement of Basin (Feet).	Number of Times cleared during the Year 1914.	Average Quantity Semi-fluid Sludge removed during the year 1914 (Cubic Yards).	Total Quantity Semi-fluid Sludge removed during the Year 1914 (Cubic Yards).
Beggs & Cobb Company, Basin No. 1, .	Jan. 15, 1910	47.0 × 23.0	6	136.00	816.00
Beggs & Cobb Company, Basin No. 2, .	May 9, 1910	47.0 × 23.0	9	135.40	1,218.60
Beggs & Cobb Company, Basin No. 3, .	Oct. 19, 1911	51.0 × 25.0	4	160.40	641.60
S. C. Parker & Son, ¹	Aug. 1, 1910	48.3 × 23.0	-	-	-
American Hide and Leather Company, Factory D.	Nov. 15, 1910	48.0 × 23.1	4	140.00	560.00
G. H. Furbush & Co., ²	July 15, 1910	49.0 × 23.2	-	-	-
B. F. Kimball & Co.,	Dec. 10, 1910	47.2 × 23.0	2½	106.84	267.10
E. Cummings Leather Company, . .	Nov. 1, 1910	45.9 × 22.6	3	97.60	292.80
W. P. Fox & Sons,	July 12, 1910	47.8 × 22.6	4½	135.20	608.40
T. F. Boyle & Co.,	Sept. 15, 1910	48.1 × 23.1	-	-	-
Bay State Leather Company, ³ . . .	Jan. 9, 1911	46.8 × 22.9	4	134.32	537.28
Van Tassell Leather Company, ⁴ . .	May 1, 1911 {	10.2 × 14.5 43.8 × 19.5	10 1	3.00 38.00	30.00 38.00
American Glue Company,	Oct. 1, 1910	47.1 × 23.0	4	136.36	545.44
Winchester Manufacturing Company, .	1902 {	35.5 × 24.7 67.2 × 12.0	4	58.74	234.96
Total,	-	-	-	-	5,790.18

¹ Successors to American Hide and Leather Company.

² Successors to Cottle Leather Company.

³ Successors to Champion Tanning Company.

⁴ Successors to Stoneham Tanning Company.

NORTH METROPOLITAN SEWERAGE SYSTEM.

Table showing Cities and Towns delivering Sewage to this System; Approximate Miles of Sewer connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1914.]

CITIES AND TOWNS.	Miles of Local Sewers connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection. ¹	Estimated Population contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
							Sq. Miles.	Sq. Miles.	Per Cent.	Per Cent.
Boston (Deer Island),	0.70	Separate,	2,775	—	1,800 ²	1,800 ²	—	—	100.0	—
Winthrop,	31.99	Separate,	4,968	4.25	11,790	12,010	1.39	1.61	98.2	86.3
Boston (East Boston),	32.85	Separate and combined,	3,960	12.80	63,690	66,440	1.15	2.18	98.7	52.8
Chelsea,	30.32	Separate and combined,	4,581	9.20	35,880	37,460	1.13	2.24	98.8	50.4
Everett,	46.87	Separate and combined,	6,529	7.05	34,060	39,100	1.97	3.34	87.1	59.0
Malden,	62.92	Separate,	3,107	6.80	42,440	49,480	3.04	6.07	85.8	59.9
Melrose,	37.82	Separate,	8,572	4.60	14,290	17,060	1.82	3.73	83.8	48.8
Boston (Charlestown),	21.22	Separate and combined,	16,241	7.90	42,440	43,760	0.67	1.27	99.3	52.8
Cambridge,	160.76	Separate and combined,	15,357	6.75	109,630	111,800	5.02	6.11	98.3	82.2
Somerville,	99.66	Separate and combined,	6,160	3.45	83,390	86,890	3.42	3.96	97.9	86.4
Medford,	60.61	Separate,	1,863	2.10	26,320	29,810	3.08	3.35	98.2	36.9
Winchester,	23.73	Separate,	1,500	5.80	9,090	10,380	1.38	6.95	87.5	23.2
Woburn,	13.08 ³	Separate,	1,782	5.20	4,930	5,380	0.99	12.71	41.1	7.8
Stoneham,	13.17	Separate,	1,782	5.80	4,930	5,380	0.99	5.50	56.6	12.5
Arlington,	27.48	Separate,	1,782	6.80	10,860	13,160	1.86	6.20	78.5	35.2
Belmont,	17.49	Separate,	713	6.80	6,260 ⁴	6,980	1.10	4.06	93.7	25.5
Wakefield,	13.51	Separate,	712	5.50	3,920	4,590	0.54	7.05	31.4	7.1
Lexington, ⁵	—	—	—	—	—	—	—	—	—	—
Revere,	37.35	Separate,	3,088	5.90	18,040	21,830	1.91	5.86	82.6	32.6
Totals,	728.73	—	78,417	6.70	524,330	532,980	31.22	90.50	89.9	34.5

¹ Estimated from assessors' statement of the number of houses in each city or town on April 1, 1914, and the population from census of 1910.

² Estimated by Supt. James H. Cronin of the institution on Deer Island.

³ Exclusive of Mystic valley sewer and tanneries.

⁴ Including 2 connections with McLean Hospital, having an estimated population of 506.

⁵ Lexington not connected.

SOUTH METROPOLITAN SEWERAGE SYSTEM.

Table showing Cities and Towns delivering Sewage to this System; Approximate Miles of Sewer connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1914.]

CITIES AND TOWNS.	Miles of Local Sewers connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection. ¹	Estimated Population now contributing Sewage.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
Boston (Back Bay),	25.54	Separate and combined,	1,711	17.20	29,430	1.15	1.61	Per Cent.	Per Cent.
Boston (Brighton),	60.05	Separate and combined,	3,474	6.40	22,320	3.17	3.74	98.5	71.4
Brookline,	70.92	Separate and combined,	4,351	7.10	30,690	3.55	6.81	68.9	84.8
Newton,	120.60	Separate,	6,770	6.00	40,620	7.55	16.88	97.8	53.1
Waltham,	41.54	Separate,	2,309	5.10	11,780	2.19	4.04	92.2	44.7
Watton (Dorchester),	46.36	Separate,	3,722	7.65	28,470	2.40	13.63	80.6	54.2
Milton (Dorchester),	54.47	Separate and combined,	5,427	8.10	43,890	2.44	4.80	92.8	17.6
Milton (Hyde Park),	13.76	Separate and combined,	742	5.20	3,860	0.79	12.59	60.0	49.9
Dorchester,	32.81	Separate,	2,231	6.70	14,960	1.54	4.57	44.3	6.3
Dorchester (Hyde Park),	16.56	Separate,	765	4.90	3,750	0.82	9.40	87.3	33.7
Dorchester (Roxbury),	54.59	Separate and combined,	3,512	5.80	22,160 ²	2.49	1.23	69.6	27.9
Boston (West Roxbury),	72.83	Separate,	4,750	4.90	23,280	3.15	12.56	63.2	25.1
Quincy,									
Totals,	610.03	- - -	39,764	6.90	275,310	31.24	100.87	67.9	31.0

¹ Estimated from assessors' statement of the number of houses in each city or town on April 1, 1914, and the population from census of 1910.

² Part of town not included in Metropolitan Sewerage District.

³ Including connection with institution at Austin Farm, having an estimated population of 1,795.

WHOLE METROPOLITAN SYSTEM.

Table showing Areas delivering Sewage to the Entire System; Approximate Miles of Sewer connected; Estimated Population and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1914.]

SYSTEM.	Miles of Local Sewers connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection.	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
North Metropolitan,	728.73	Separate and combined,	78,417	6.7	524,330	582,930	Sq. Miles. 31.22	Sq. Miles. 90.50	Per Cent. 89.9	Per Cent. 34.5
South Metropolitan,	610.03	Separate and combined,	39,764	6.9	275,310	405,240	31.24	100.87	67.9	31.0
Totals,	1,338.76	-	118,181	6.8	799,640	988,170	62.46	191.37	80.9	32.6

PUMPING STATIONS.

CAPACITY AND RESULTS.

It will be noticed that the pumping expense per million foot-gallons in four stations is slightly in excess of that of last year. This is due principally to an increase in rate of wages of firemen and oilers in the large stations and of engineers in the small stations. This increase extended over practically seven months of the year. At the Ward Street Station considerable expense has been incurred by reason of repairs to the valves in the pumps. In one station only, East Boston, is there a reduction in the cost per million foot-gallons of pumping as compared with last year.

Average Daily Volume of Sewage lifted at Each of the Six Principal Metropolitan Pumping Stations and the Quincy Sewage Lifting Station during the Year, as compared with the Corresponding Volumes for the Previous Year.

PUMPING STATION.	AVERAGE DAILY PUMPAGE.			
	Jan. 1, 1913, to Dec. 31, 1913.	Jan. 1, 1914, to Dec. 31, 1914.	Increase during the Year.	
	Gallons.	Gallons.	Gallons.	Per Cent.
Deer Island,	56,600,000	58,700,000	2,100,000	3.7
East Boston,	54,600,000	56,700,000	2,100,000	3.8
Charlestown,	33,700,000	32,600,000	1,100,000 ¹	3.3 ¹
Alewife Brook,	3,614,000	3,506,000	108,000 ¹	3.0 ¹
Quincy,	4,154,000	3,993,000	161,000 ¹	3.9 ¹
Ward Street (actual gallons pumped),	27,056,000	26,718,000	338,000 ¹	1.2 ¹
Quincy sewage lifting station,	68,700	84,500	15,800	23.0

¹ Decrease.

NORTH METROPOLITAN SYSTEM.

Deer Island Pumping Station.

At this station are four submerged centrifugal pumps with impellers or wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of 1 pump: 100,000,000 gallons, with 19-foot lift.

Contract capacity of 3 pumps: 45,000,000 gallons each, with 19-foot lift.

Average duty for the year: 54,400,000 foot-pounds.

Average quantity raised each day: 58,700,000 gallons.

Force employed: 4 engineers, 1 relief engineer, 4 firemen, 4 oilers, 3 screenmen, 1 relief screenman and 1 laborer.

Coal used: New River and Sterling, costing from \$3.94 to \$4.65 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the Deer Island Pumping Station of the North Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons.)	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1914.						
January,	2,092,200,000	67,500,000	51,800,000	112,000,000	11.59	55,800,000
February,	1,845,200,000	65,900,000	54,900,000	89,700,000	11.56	57,600,000
March,	2,404,900,000	77,600,000	53,400,000	149,700,000	11.78	56,100,000
April,	2,399,000,000	80,000,000	61,700,000	132,000,000	11.77	55,100,000
May,	2,381,900,000	76,800,000	52,700,000	113,500,000	11.30	60,800,000
June,	1,629,900,000	54,300,000	43,800,000	65,300,000	10.61	61,600,000
July,	1,604,800,000	51,800,000	40,400,000	85,200,000	10.73	56,100,000
August,	1,382,600,000	44,600,000	33,600,000	73,700,000	10.58	49,800,000
September,	1,364,600,000	45,500,000	34,800,000	56,200,000	10.58	56,700,000
October,	1,406,300,000	45,400,000	35,600,000	82,200,000	10.99	45,700,000
November,	1,298,300,000	43,300,000	33,800,000	90,000,000	10.70	47,600,000
December,	1,582,600,000	51,100,000	36,700,000	84,200,000	10.73	49,600,000
Total,	21,392,300,000	-	-	-	-	-
Average,	-	58,700,000	44,400,000	94,500,000	11.08	54,400,000

Average Cost per Million Foot-gallons for Pumping at the Deer Island Station.

Volume (21,392.3 Million Gallons) × Lift (11.08 Feet) = 237,026.7 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor,	\$15,814 90	\$0.06672
Coal,	10,625 60	.04483
Oil,	351 55	.00148
Waste,	104 86	.00044
Water,	1,470 00	.00620
Packing,	189 18	.00080
Miscellaneous supplies and renewals,	1,767 32	.00746
Totals,	\$30,323 41	\$0.12793
Labor at screens,	-	.01302

East Boston Pumping Station.

At this station are four submerged centrifugal pumps, with impellers or wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of 1 pump: 100,000,000 gallons with 19-foot lift.

Contract capacity of 3 pumps: 45,000,000 gallons each, with 19-foot lift.

Average duty for the year: 64,800,000 foot-pounds.

Average quantity raised each day: 56,700,000 gallons.

Force employed: 4 engineers, 2 relief engineers, 3 firemen, 1 relief fireman, 4 oilers, 3 screenmen, 1 relief screenman, 3 helpers and 1 laborer.

Coal used: New River and Sterling, costing from \$3.89 to \$4.54 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the East Boston Pumping Station of the North Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1914.						
January,	2,030,200,000	65,500,000	49,800,000	110,000,000	16.53	59,400,000
February,	1,789,200,000	63,900,000	52,900,000	87,700,000	16.07	59,000,000
March,	2,342,900,000	75,600,000	51,400,000	147,700,000	15.63	64,000,000
April,	2,339,000,000	78,000,000	59,700,000	130,000,000	15.38	66,900,000
May,	2,319,900,000	74,800,000	50,700,000	111,500,000	15.42	71,000,000
June,	1,569,900,000	52,300,000	41,800,000	63,300,000	13.27	64,100,000
July,	1,542,800,000	49,800,000	38,400,000	83,200,000	17.36	62,400,000
August,	1,320,600,000	42,600,000	31,600,000	71,700,000	18.42	63,500,000
September,	1,304,600,000	43,500,000	32,800,000	54,200,000	17.31	73,300,000
October,	1,344,300,000	43,400,000	33,600,000	80,200,000	16.87	62,900,000
November,	1,238,300,000	41,300,000	31,800,000	88,000,000	15.26	62,200,000
December,	1,520,600,000	49,100,000	34,700,000	82,200,000	15.28	69,000,000
Total,	20,662,300,000	—	—	—	—	—
Average,	—	56,700,000	42,400,000	92,500,000	16.07	64,800,000

Average Cost per Million Foot-gallons for Pumping at the East Boston Station.

Volume (20,662.3 Million Gallons) × Lift (16.07 Feet) = 332,043.2 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor,	\$21,268 89	\$0.06406
Coal,	12,842 92	.03868
Oil,	425 98	.00128
Waste,	133 90	.00040
Water,	1,980 00	.00596
Packing,	70 00	.00021
Miscellaneous supplies and renewals,	2,183 42	.00658
Totals,	\$38,905 11	\$0.11717
Labor at screens,	—	.00940

Charlestown Pumping Station.

At this station are three submerged centrifugal pumps, two of them having impellers or wheels 7.5 feet in diameter, the other 8.25 feet in diameter. They are driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of 1 pump: 60,000,000 gallons with 8-foot lift.

Contract capacity of 2 pumps: 22,000,000 gallons each, with 11-foot lift.

Average duty for the year: 43,600,000 foot-pounds.

Average quantity raised each day: 32,600,000 gallons.

Force employed: 4 engineers, 1 relief engineer, 4 firemen, 3 oilers, 3 screenmen and 1 relief screenman.

Coal used: New River and Sterling, costing from \$4.05 to \$4.50 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the Charlestown Pumping Station of the North Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average Per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1914.						
January,	1,020,500,000	32,900,000	22,700,000	55,800,000	8.10	41,000,000
February,	976,800,000	34,900,000	25,900,000	46,500,000	8.25	47,800,000
March,	1,260,500,000	40,700,000	27,300,000	69,100,000	8.49	42,400,000
April,	1,303,400,000	43,400,000	32,700,000	69,100,000	8.41	48,800,000
May,	1,268,900,000	40,900,000	29,600,000	59,300,000	8.40	48,800,000
June,	1,140,600,000	38,000,000	28,000,000	50,900,000	8.07	54,000,000
July,	937,500,000	30,200,000	22,500,000	54,900,000	7.91	39,000,000
August,	838,700,000	27,100,000	20,100,000	43,700,000	7.53	36,400,000
September,	794,700,000	26,500,000	20,500,000	32,700,000	8.04	42,200,000
October,	804,100,000	25,900,000	19,400,000	46,300,000	7.84	37,200,000
November,	709,700,000	23,700,000	16,800,000	50,800,000	7.79	35,200,000
December,	841,000,000	27,100,000	18,900,000	45,300,000	11.38	50,000,000
Total,	11,896,400,000	—	—	—	—	—
Average,	—	32,600,000	23,700,000	52,000,000	8.35	43,600,000

*Average Cost per Million Foot-gallons for Pumping at the Charlestown Station.*Volume (11,896.4 Million Gallons) \times Lift (8.35 Feet) = 99,334.9 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor,	\$13,961 89	\$0.14055
Coal,	5,086 98	.05121
Oil,	131 62	.00133
Waste,	92 57	.00093
Water,	741 60	.00747
Packing,	64 92	.00065
Miscellaneous supplies and renewals,	971 41	.00978
Totals,	\$21,050 99	\$0.21192
Labor at screens,	-	.03260

Alewife Brook Pumping Station.

The plant at this station consists of two 9-inch Andrews commercial centrifugal pumps, direct connected by horizontal shafts to compound marine engines, together with a pump and engine added later. The latter consists of a specially designed engine of the vertical cross-compound type, having between the cylinders a centrifugal pump rotating on a horizontal axis.

Contract capacity of the two original pumps: 4,500,000 gallons each, with 13-foot lift.

Contract capacity of new pump: 13,000,000 gallons, with 13-foot lift.

Average duty for the year: 17,100,000 foot-pounds.

Average quantity raised each day: 3,506,000 gallons.

Force employed: 3 engineers, 1 relief engineer, 3 screenmen and 1 relief screenman.

Coal used: New River, costing from \$4.88 to \$5.13 per gross ton.

Table of Approximate Quantities, Lifts and Duties at the Alewife Brook Pumping Station of the North Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average Per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1914.						
January,	117,021,000	3,775,000	3,079,000	6,271,000	12.92	18,000,000
February,	122,646,000	4,380,000	3,766,000	5,364,000	12.75	19,000,000
March,	173,784,000	5,606,000	4,318,000	9,453,000	12.86	20,500,000
April,	197,224,000	6,574,000	5,106,000	8,347,000	12.90	22,400,000
May,	176,717,000	5,701,000	3,478,000	7,462,000	12.85	21,100,000
June,	87,183,000	2,906,000	2,288,000	4,027,000	12.81	16,700,000
July,	76,790,000	2,477,000	2,036,000	4,554,000	12.95	15,600,000
August,	67,043,000	2,163,000	1,784,000	3,862,000	12.88	13,800,000
September,	60,089,000	2,002,000	1,784,000	2,288,000	12.97	14,000,000
October,	63,089,000	2,035,000	1,826,000	3,718,000	12.95	14,800,000
November,	61,891,000	2,063,000	1,742,000	3,718,000	12.93	14,000,000
December,	74,115,000	2,391,000	1,952,000	4,677,000	12.95	15,100,000
Total,	1,277,572,000	-	-	-	-	-
Average,	-	3,506,000	2,763,000	5,312,000	12.89	17,100,000

Average Cost per Million Foot-gallons for Pumping at the Alewife Brook Station.

Volume (1,277.572 Million Gallons) \times Lift (12.89 Feet) = 16,467.9 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor,	\$6,678 54	\$0.40555
Coal,	2,074 77	.12599
Oil,	120 76	.00733
Waste,	123 97	.00753
Water,	209 16	.01271
Packing,	30 31	.00184
Miscellaneous supplies and renewals,	229 97	.01396
Totals,	\$9,467 48	\$0.57491
Labor at screens, oiling and miscellaneous services,	-	.11370

SOUTH METROPOLITAN SYSTEM.

Ward Street Pumping Station.

At this station are two vertical, triple-expansion pumping engines, of the Allis-Chalmers type, operating reciprocating pumps, the plungers of which are 48 inches in diameter with a 60-inch stroke.

Contract capacity of 2 pumps: 50,000,000 gallons each, with 45-foot lift.

Average duty for the year: 79,800,000 foot-pounds.

Average quantity raised each day: 26,718,000 gallons.

Force employed: 4 engineers, 1 relief engineer, 4 firemen, 5 oilers, 4 assistant engineers, 1 machinist and 1 laborer.

Coal used: New River and Sterling, costing from \$4.66 to \$5.15 per gross ton.

Material intercepted at screens during the year, 1,213 cubic yards.

Table of Approximate Quantities, Lifts and Duties at the Ward Street Pumping Station of the South Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1914.						
January,	866,904,000	27,966,000	23,570,000	45,854,000	41.55	89,000,000
February,	811,156,000	28,970,000	23,575,000	34,308,000	42.45	94,700,000
March,	1,127,437,000	36,366,000	28,033,000	59,358,000	42.06	92,700,000
April,	1,205,640,000	40,188,000	34,273,000	56,430,000	41.96	92,300,000
May,	1,158,814,000	37,381,000	25,801,000	50,798,000	42.42	88,300,000
June,	739,490,000	24,650,000	20,748,000	28,848,000	41.70	77,800,000
July,	683,907,000	22,062,000	19,300,000	33,703,000	41.17	76,700,000
August,	652,307,000	21,062,000	17,513,000	32,350,000	40.90	74,200,000
September,	613,448,000	20,448,000	18,078,000	22,307,000	40.77	73,300,000
October,	635,945,000	20,514,000	17,508,000	31,703,000	40.69	68,900,000
November,	603,261,000	20,109,000	16,563,000	31,933,000	40.69	66,500,000
December,	648,014,000	20,905,000	17,020,000	30,781,000	40.80	63,500,000
Total,	9,746,323,000	—	—	—	—	—
Average,	—	26,718,000	21,832,000	38,198,000	41.43	79,800,000

Records from plunger displacement.

Average Cost-per Million Foot-gallons for Pumping at the Ward Street Station.

Volume (9,746.3 Million Gallons) × Lift (41.43 Feet) = 403,789.2 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot- gallons.
Labor,	\$17,708 08	\$0.04385
Coal,	9,199 38	.02278
Oil,	212 85	.00053
Waste,	39 09	.00009
Water,	1,533 60	.00380
Packing,	257 41	.00064
Miscellaneous supplies and renewals,	3,705 57	.00918
Totals,	\$32,655 98	\$0.08087
Labor at screens,	—	.00967

Quincy Pumping Station.

At this station are two compound condensing Deane pumping engines and one Lawrence centrifugal pump driven by a Sturtevant compound condensing engine.

Contract capacity of 3 pumps: Deane, 3,000,000 gallons; Deane, 5,000,000 gallons; Lawrence centrifugal, 10,000,000 gallons.

Average duty for the year: 28,410,000 foot-pounds.

Average quantity raised each day: 3,993,000 gallons.

Force employed: 3 engineers, 1 relief engineer, 3 screenmen and 1 relief screen-man.

Coal used: Bituminous, costing from \$4.64 to \$5.04 per gross ton.

Materials intercepted at screen during the year, 215.3 cubic yards.

Table of Approximate Quantities, Lifts and Duties at the Quincy Pumping Station of the South Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet.)	Average Duty (ft.-lbs. per 100 lbs. Coal).
1914.						
January,	130,085,000	4,196,000	3,487,000	4,766,000	21.52	30,400,000
February,	127,803,000	4,564,000	3,899,000	5,558,000	22.53	27,500,000
March,	183,745,000	5,927,000	4,654,000	10,546,000	23.92	29,100,000
April,	187,618,000	6,254,000	5,456,000	8,204,000	26.74	30,200,000
May,	189,558,000	6,115,000	4,492,000	7,442,000	26.08	30,300,000
June,	117,637,000	3,921,000	3,177,000	4,760,000	21.10	30,500,000
July,	101,880,000	3,286,000	2,860,000	3,795,000	21.03	30,500,000
August,	91,572,000	2,954,000	2,612,000	3,328,000	21.35	28,200,000
September,	80,950,000	2,698,000	2,328,000	3,025,000	21.15	27,400,000
October,	75,483,000	2,435,000	2,218,000	2,731,000	21.00	24,800,000
November,	75,092,000	2,503,000	2,018,000	2,977,000	21.13	25,400,000
December,	94,984,000	3,064,000	2,335,000	3,702,000	21.03	26,600,000
Total,	1,456,407,000	-	-	-	-	-
Average,	-	3,993,000	3,295,000	5,070,000	22.38	28,410,000

Average Cost per Million Foot-gallons for Pumping at the Quincy Station.

Volume (1,456.4 Million Gallons) × Lift (22.38 Feet) = 32,594.2 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor,	\$6,518 27	\$0.19998
Coal,	2,110 44	.06476
Oil,	28 18	.00086
Waste,	36 09	.00111
Water,	212 23	.00651
Packing,	29 74	.00091
Miscellaneous supplies and renewals,	527 54	.01618
Totals,	\$9,462 49	\$0.29031
Labor at screens, oiling and miscellaneous services,	-	.04963

Nut Island Screen-house.

The plant at this house includes two sets of screens in duplicate actuated by small reversing engines of the Fitchburg type. Two vertical Deane boilers, 80 horse-power each, operate the engines, provide heat and light for the house, burn materials intercepted at the screens, and furnish power for the Quincy sewage lifting station.

Average daily quantity of sewage passing screens, 52,600,000 gallons.

Total materials intercepted at screens, 1,155.35 cubic yards.

Materials intercepted per million gallons of sewage discharged, 1.61 cubic feet.

Force employed: 3 engineers, 1 relief engineer, 3 screenmen and 1 relief screenman.

Coal used: Sterling-Elmora, costing from \$4.14 to \$4.75 per gross ton.

Quincy Sewage Lifting Station.

At this station are two 6-inch submerged Lawrence centrifugal pumps with vertical shafts actuated by two Sturtevant direct-current motors.

The labor and electric energy for this station are supplied from the Nut Island screen-house and as used at present it does not materially increase the amount of coal used at the latter station. The effluent is largely ground water.

Average daily amount pumped, 84,500 gallons.

Average lift, 16.16 feet.

Coal delivered in the Bins of the Sewerage Works Pumping Stations during the Year.

	GROSS TONS, BITUMINOUS COAL.							Price per Gross Ton. ¹
	Deer Island Pumping Station.	East Boston Pumping Station.	Charlestown Pumping Station.	Alewife Brook Pumping Station.	Ward Street Pumping Station.	Quincy Pumping Station.	Nut Island Screen-house.	
Gorman-Leonard Coal Company,	799	-	-	-	-	-	-	\$3 94
Metropolitan Coal Company, .	688	-	-	-	-	-	-	4 63
Metropolitan Coal Company, .	678	-	-	-	-	-	-	4 64
Gorman-Leonard Coal Company,	-	425.90	-	-	-	-	-	3 89
Gorman-Leonard Coal Company,	-	584.07	-	-	-	-	-	3 94
Gorman-Leonard Coal Company,	-	844.00	-	-	-	-	-	3 98
Metropolitan Coal Company, .	-	363.00	-	-	-	-	-	4 36
Metropolitan Coal Company, .	-	371.00	-	-	-	-	-	4 37
Metropolitan Coal Company, .	-	372.00	-	-	-	-	-	4 50
Metropolitan Coal Company, .	-	364.00	-	-	-	-	-	4 54
Gorman-Leonard Coal Company,	-	-	167	-	-	-	-	4 05
Metropolitan Coal Company, .	-	-	246	-	-	-	-	4 41
Metropolitan Coal Company, .	-	-	300	-	-	-	-	4 45
Metropolitan Coal Company, .	-	-	295	-	-	-	-	4 52
Locke Coal Company, .	-	-	-	44.660	-	-	-	4 86
Locke Coal Company, .	-	-	-	196.963	-	-	-	4 92
Locke Coal Company, .	-	-	-	41.380	-	-	-	5 02
Locke Coal Company, .	-	-	-	8.013	-	-	-	5 03
Locke Coal Company, .	-	-	-	79.326	-	-	-	5 13
Gorman-Leonard Coal Company,	-	-	-	-	20.796	-	-	3 25
Gorman-Leonard Coal Company,	-	-	-	-	33.310	-	-	4 66
Gorman-Leonard Coal Company,	-	-	-	-	249.563	-	-	4 80
Gorman-Leonard Coal Company,	-	-	-	-	341.441	-	-	4 83
Metropolitan Coal Company, .	-	-	-	-	250.680	-	-	4 93
Metropolitan Coal Company, .	-	-	-	-	302.308	-	-	4 98
Metropolitan Coal Company, .	-	-	-	-	293.477	-	-	5 00
Metropolitan Coal Company, .	-	-	-	-	92.710	-	-	5 03
Metropolitan Coal Company, .	-	-	-	-	107.602	-	-	5 04
Metropolitan Coal Company, .	-	-	-	-	268.602	-	-	5 15
Frost Coal Company, .	-	-	-	-	-	49.178	-	4 64
Frost Coal Company, .	-	-	-	-	-	49.400	-	4 69
Frost Coal Company, .	-	-	-	-	-	50.714	-	4 81

¹ Includes adjustments for quality.

Coal delivered in the Bins of the Sewerage Works Pumping Stations during the Year — Concluded.

	GROSS TONS, BITUMINOUS COAL.							Price per Gross Ton. ¹
	Deer Island Pumping Station.	East Boston Pumping Station.	Charlestown Pumping Station.	Alewife Brook Pumping Station.	Ward Street Pumping Station.	Quincy Pumping Station.	Nut Island Screen-house.	
Frost Coal Company, . . .	-	-	-	-	-	48.455	-	\$4 82
Frost Coal Company, . . .	-	-	-	-	-	15.736	-	4 88
Frost Coal Company, . . .	-	-	-	-	-	33.370	-	4 89
Frost Coal Company, . . .	-	-	-	-	-	61.770	-	4 92
Frost Coal Company, . . .	-	-	-	-	-	51.446	-	5 00
Frost Coal Company, . . .	-	-	-	-	-	59.250	-	5 04
Gorman-Leonard Coal Company,	-	-	-	-	-	-	117.133	4 14
Gorman-Leonard Coal Company,	-	-	-	-	-	-	162.890	4 35
Metropolitan Coal Company, .	-	-	-	-	-	-	75.000	4 75
Total gross tons, . . .	2,165	3,323.97	1,008	370.342	1,960.489	419.819	355.023	-
Average price per gross ton, .	\$4 37	\$4 15	\$4 39	\$4 97	\$4 93	\$4 86	\$4 37	-

¹ Includes adjustments for quality.

METROPOLITAN SEWERAGE OUTFALLS.

The Deer Island outfall has been in continuous operation since May, 1895.

The 60-inch outfall pipes on the South Metropolitan System have been in operation since October, 1904.

These outfalls are in good condition and free from deposit. During the year the average flow through the North Metropolitan outfall at Deer Island has been 58,700,000 gallons of sewage per 24 hours, with a maximum rate of 149,700,000 gallons on March 2, 1914. The amount of sewage discharged in the North Metropolitan District averaged 112 gallons per day for each person, taking the estimated population of the district contributing sewage. If the sewers in this district were restricted to the admission of sewage proper only and all local sewers were separate sewers, this per capita amount would be considerably decreased.

In the South Metropolitan district an average of 52,600,000 gallons of sewage has passed daily through the screens at the Nut Island

screen-house, and has been discharged from the outfalls into the outer harbor. The maximum rate of discharge per day, which occurred during a heavy storm on March 1, 1914, was 165,000,000 gallons. The discharge of sewage through these outfalls represents the amount of sewage contributed in the South Metropolitan System, which was at the rate of 191 gallons per day per person of the estimated number contributing sewage in the District.

The daily discharge of sewage per capita is considerably larger in the South Metropolitan District than it is in the North Metropolitan District, because, owing to the large size of the High-level sewer, more storm water is admitted at periods of heavy rainfall.

Material Intercepted at the Screens.

The material intercepted at the screens at the North Metropolitan Sewerage stations, consisting of rags, paper and other floating materials, has during the year amounted to 3,057.8 cubic yards. This is equivalent to 3.86 cubic feet for each million gallons of sewage pumped at Deer Island.

The material intercepted at the screens at the South Metropolitan Sewerage stations has amounted to 2,583.94 cubic yards, equal to 3.63 cubic feet per million gallons of sewage delivered at the outfall works at Nut Island.

Studies of sewage flows in the Metropolitan sewers and siphons indicate that they are free from deposit.

Respectfully submitted,

FREDERICK D. SMITH,

Engineer of Sewerage Works.

BOSTON, January 1, 1915.

APPENDIX.

APPENDIX No. 1.

CONTRACTS MADE AND PENDING

[NOTE. — The details of contracts made before

1. Number of Contract.	2. WORK.	3. Num- ber of Bids.	AMOUNT OF BID.		6. Contractor.	
			4. Next to Lowest.	5. Lowest.		
1	352 ¹	324 tons cast-iron water pipe; 270 tons 42-inch, 54 tons 36-inch pipe; and 25 tons special castings.	3	\$9,141 80	\$8,470 60 ¹	United States Cast Iron Pipe & Foundry Co., Philadelphia, Pa.
2	353 ¹	2 steel casings for shafts of water pipe tunnel under Chelsea Creek.	7	1,263 00	1,262 00 ¹	Roberts Iron Works Co., Cambridge, Mass.
3	354	Constructing water pipe tunnel under Chelsea Creek, between East Boston and Chelsea.	4	62,695 00	60,300 00 ¹	Coleman Brothers, Chelsea, Mass.
4	355 ¹	1,050 tons cast iron water pipe; 530 tons 24-inch, 480 tons 20-inch, 30 tons 12-inch, 10 tons 8-inch pipe; and 25 tons special castings.	3	23,247 50	23,195 00 ¹	Warren Foundry & Machine Co., Phillipsburg, N. J.
5	356 ¹	1,050 tons 24-inch cast-iron water pipe, and 25 tons special castings.	4	22,985 00	22,775 00 ¹	Warren Foundry & Machine Co., Phillipsburg, N. J.
6	357	Steel tank or reservoir on Bellevue Hill.	5	19,540 00	19,397 00 ¹	Walsh's Holyoke Steam Boiler Works, Holyoke, Mass.
7	358 ¹	Water valves; 5 24-inch, 6 20-inch and 2 12-inch screw lift valves.	4	3,130 00	2,873 00 ¹	Coffin Valve Co., Boston.
8	359	Laying 24-inch water pipes in Boston, Milton and Quincy.	15	16,225 00	15,208 20 ¹	John J. Evans, Lawrence, Mass.

¹ Contract based upon this bid.

APPENDIX No. 1.

DURING THE YEAR 1914 — WATER WORKS.

1914 have been given in previous reports.]

7.	8.	9.	10.	
Date of Contract.	Date of Completion of Contract.	Prices of Principal Items of Contracts made in 1914.	Value of Work done Dec. 31, 1914.	
Feb. 27, 1914	Oct. 3, 1914	For pipes, \$21.90 per ton of 2,000 pounds; for special castings, \$55 per ton of 2,000 pounds.	\$8,447 14	1
Feb. 26, 1914	May 25, 1914	For whole work, \$1,262.	1,262 00	2
Apr. 27, 1914	-	For spruce piles driven and cut off, \$0.30 per lin. ft.; for oak piles driven and cut off, \$0.60 per lin. ft.; for long leaf yellow pine lumber in place for bulkhead, shaft and fender guards and pipe line foundations, \$60 per M. feet B. M.; for long leaf yellow pine lumber in place for walks and fences, \$78 per M. feet B. M.; for constructing tunnel, \$78 per lin. ft.; for laying 36-inch and 24-inch cast-iron water pipe, \$1.50 per lin. ft.; for removing existing 24-inch cast-iron water pipe, \$1 per lin. ft.; for earth filling on land of Commonwealth, \$0.40 per cu. yd.; for rock excavation, \$10 per cu. yd.	60,280 00	3
June 23, 1914	Nov. 6, 1914	For pipes, \$20.90 per ton of 2,000 pounds; for special castings, \$50 per ton of 2,000 pounds.	23,481 34	4
June 23, 1914	Nov. 6, 1914	For pipes, \$20.50 per ton of 2,000 pounds; for special castings, \$50 per ton of 2,000 pounds.	23,540 00	5
Aug. 7, 1914	-	For whole work, \$19,397.	17,460 00	6
July 15, 1914	Nov. 18, 1914	For 24-inch screw lift valves, \$265 each; for 20-inch screw lift valves, \$223 each; for 12-inch screw lift valves, \$105 each.	2,873 00	7
Aug. 4, 1914	-	For laying 24-inch cast-iron pipe, \$1.05 per lin. ft.; for rock excavation above regular grade of bottom of trench, \$4.80 per cu. yd.; for rock excavation below grade, \$5.50 per cu. yd.; for earth excavation below grade, \$0.75 per cu. yd.; for chambers for 24-inch valves, \$60 per chamber; for chambers for 16-inch and smaller valves, \$55 per chamber; for concrete masonry, \$6 per cu. yd.	12,780 00	8

* Contract completed.

CONTRACTS MADE AND PENDING DURING

1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID.		6. Contractor.
			4. Next to Lowest.	5. Lowest.	
9	360 ² Laying 20-inch water pipes in Boston.	13	\$5,007 00 ¹	\$4,820 22	Charles R. Gow Co., West Roxbury, Mass.
10	361 ² Constructing foundation for reservoir on Bellevue Hill.	21	6,155 00	5,874 00 ¹	John E. Palmer, Boston.
11	362 3,930 tons 60-inch cast-iron water pipe; 120 tons special castings.	4	87,547 50	82,908 00 ¹	United States Cast Iron Pipe & Foundry Co., Philadelphia, Pa.
12	363 2,800 tons 60-inch cast-iron water pipe; 100 tons special castings.	— ²	— ²	— ²	United States Cast Iron Pipe & Foundry Co., Philadelphia, Pa.
13	31-M ² 450 tons C. C. B. New River coal for Arlington pumping station.	1	—	\$4.38 ¹ per ton.	Bader Coal Co., Boston.
14	32-M ² 750 tons Georges Creek Cumberland or New River coal for Spot Pond pumping station.	1	—	\$5.30 ¹ per ton.	Locke Coal Co., Malden.
15	33-M ² 5,000 tons Beaver Run coal for Chestnut Hill pumping stations; 300 tons Beaver Run coal for Hyde Park pumping station, and 85 tons Beaver Run coal for Pegan pumping station.	Chestnut Hill stations, 3. Hyde Park station, 4. Pegan station, 3.	\$4.02 ¹ per ton.	\$3.97 per ton.	Gorman-Leonard Coal Co., Worcester.
			\$4.17 ¹ per ton.	\$4.12 per ton.	
			\$4.24 ¹ per ton.	\$4.19 per ton.	
16	34-M ² Fuel economizer and appurtenances for Chestnut Hill pumping station No. 1.	2	\$1,644 00	\$1,480 00 ¹	B. F. Sturtevant Co. Boston.
17	35-M 400 tons C. C. B. New River coal for Arlington pumping station.	2	\$4.28 ¹ per ton.	\$4.20 per ton.	Bader Coal Co., Boston.
18	36-M 700 tons C. C. B. New River coal for Spot Pond pumping station.	2	\$5.30 per ton.	\$5.10 ¹ per ton.	Bader Coal Co., Boston.
19	37-M 4,000 tons Beaver Run coal for Chestnut Hill pumping stations, and 260 tons Sterling coal for Hyde Park pumping station.	Chestnut Hill stations, 5. Hyde Park station, 3.	\$3.94 per ton.	\$3.89 per ton.	Gorman-Leonard Coal Co., Worcester.
			\$4.33 per ton.	\$4.10 ¹ per ton.	

¹ Contract based upon this bid.² Contract completed.

THE YEAR 1914 — WATER WORKS — *Continued.*

7.	8.	9.	10.	
Date of Contract.	Date of Completion of Contract.	Prices of Principal Items of Contracts made in 1914.	Value of Work done Dec. 31, 1914.	
Aug. 7, 1914	Nov. 25, 1914	For laying 20-inch cast-iron pipe, \$0.90 per lin. ft.; for rock excavation above regular grade of bottom of trench, \$3 per cu. yd.; for rock excavation below grade, \$6 per cu. yd.; for earth excavation below grade, \$1 per cu. yd.; for chambers for 20-inch valves, \$75 per chamber; for chambers for 12-inch and smaller valves, \$40 per chamber; for concrete masonry, \$7 per cubic yd.	\$6,898 23	9
Aug. 4, 1914	Oct. 6, 1914	For earth excavation, \$0.48 per cu. yd.; for rock excavation, \$4 per cu. yd.; for concrete masonry, \$6.70 per cu. yd.	6,382 28	10
Nov. 25, 1914	-	For pipes, \$19.60 per ton of 2,000 pounds; for special castings, \$49 per ton of 2,000 pounds.	12,350 00	11
Nov. 28, 1914	-	For pipes, \$19.60 per ton of 2,000 pounds; for special castings, \$49 per ton of 2,000 pounds.	-	12
June 25, 1913	May 23, 1914	-	2,030 30	13
June 25, 1913	June 1, 1914	-	3,872 67	14
July 1, 1913	Aug. 10, 1914	-	21,691 59	15
Mar. 16, 1914	June 30, 1914	For whole work, \$1,830, less allowance of \$350 for old economiser.	1,480 00	16
June 25, 1914	-	\$4.28 per ton of 2,240 pounds delivered on cars at the Arlington station.	1,099 53	17
June 25, 1914	-	\$5.10 per ton of 2,240 pounds delivered in bins at the Spot Pond station.	2,481 03	18
June 25, 1914	-	\$4.02 per ton of 2,240 pounds delivered on cars at the Chestnut Hill stations; \$4.10 per ton of 2,240 pounds delivered on cars at the Hyde Park station.	9,136 06	19

* Contractor for No. 362 agreed to accept prices bid under that contract for the additional quantities included in No. 363.

CONTRACTS MADE AND PENDING DURING

1.	2.	3.	AMOUNT OF BID.		6.	
			4.	5.		
Number of Contract.	WORK.	Number of Bids.	Next to Lowest.	Lowest.	Contractor.	
20	38-M ¹	Repaving 24-inch water pipe trench in Broadway, Chelsea.	5	\$1.65 per sq. yd.	\$1.60 ¹ per sq. yd.	C. W. Dolloff & Co., Boston.
21	39-M	Sale and purchase of electric energy to be developed at the Sudbury Dam.	2	\$5.50 ¹ per M. kilowatt hours.	\$6.25 ^{1, 4} per M. kilowatt hours.	Edison Electric Illuminating Co., Boston.
22	Special ² Order.	Pelton water wheel for machine shop at Chestnut Hill pumping station.	- ⁶	- ⁶	- ⁶	Pelton Water Wheel Co., New York.
23	Special ² Order.	1 20-inch Venturi meter tube; 1 Type M register indicator recorder.	- ⁶	- ⁶	- ⁶	Builders Iron Foundry, Providence, R. I.
24	Special ² Order.	1 16-inch Venturi meter tube; 1 Type M register indicator recorder.	- ⁶	- ⁶	- ⁶	Builders Iron Foundry, Providence, R. I.

¹ Contract based upon this bid.² Contract completed.

THE YEAR 1914 — WATER WORKS — *Continued.*

7. Date of Contract.	8. Date of Completion of Contract.	9. Prices of Principal Items of Contracts made in 1914.	10. Value of Work done Dec. 31, 1914.	
Sept. 2, 1914	Oct. 12, 1914	For taking up temporary pavement and repaving with granite blocks (furnished by the Commonwealth) on a concrete base, \$1.60 per square yard.	\$1,319 68	20
Dec. 21, 1914	-	Estimated amount of electric energy available per year, 3,000,000 kilowatt hours.	-	21
Dec. 4, 1913	May 1, 1914	-	350 00	22
Mar. 4, 1914	Apr. 30, 1914	For meter tube and indicator recorder, \$765, . .	765 00	23
Aug. 13, 1914	Sept. 25, 1914	For meter tube and indicator recorder, \$655, . .	655 00	24
			\$220,634 96	

* Highest bid.

* Next to highest bid.

* Competitive bids were not received.

CONTRACTS MADE AND PENDING DURING THE YEAR 1914 — WATER WORKS —
Concluded.

Summary of Contracts.¹

	Value of Work done Dec. 31, 1914.
Distribution Department, 12 contracts,	\$175,754 05
346 contracts completed from 1896 to 1913, inclusive,	16,875,638 35
	\$17,051,392 40
Deduct for work done on 11 Sudbury Reservoir contracts by the city of Boston, .	512,000 00
Total of 369 contracts,	\$16,539,392 40

¹ In this summary contracts charged to maintenance are excluded.

APPENDIX NO. 2.

TABLE No. 1. — *Monthly Rainfall in Inches at Various Places on the Metropolitan Water Works, in 1914.*

PLACE.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
Princeton,	3.13	3.40	3.46	4.80	2.52	2.02	4.58	3.99	0.11	1.53	3.24	3.98	36.51
Jefferson,	3.61	4.05	4.75	5.36	3.50	2.20	4.02	5.30	0.19	1.93	3.46	4.03	42.40
Sterling,	3.00	3.51	4.45	4.65	2.77	1.91	3.80	4.59	0.15	1.82	2.39	4.00	37.04
Boyleston,	3.85	3.36	4.67	4.82	3.26	1.86	3.28	4.14	0.13	2.19	2.78	3.85	38.19
Sudbury Dam,	3.86	4.18	4.34	4.88	2.80	1.84	3.48	3.86	0.24	1.62	2.56	3.64	37.30
Framingham,	3.69	3.80	4.38	4.82	2.82	2.02	2.76	3.50	0.18	1.56	2.44	3.36	35.33
Ashland Dam,	3.58	4.06	4.45	4.87	3.10	1.66	2.99	4.00	0.36	1.60	2.38	3.24	36.29
Cordaville,	4.27	4.25	5.13	5.85	3.61	2.06	4.54	3.90	0.39	1.60	2.73	3.59	41.92
Lake Cochituate,	3.53	4.11	4.41	4.93	2.71	1.59	3.17	3.62	0.27	1.69	2.45	3.38	36.86
Chestnut Hill Reservoir,	3.96	4.34	4.42	6.19	2.77	1.73	2.77	3.83	0.35	1.71	2.94	3.98	38.99
Spot Pond,	3.36	3.77	4.64	6.52	2.64	2.26	2.93	3.21	0.24	1.52	2.68	3.37	37.14
Average of all,	3.62	3.89	4.46	5.25	2.96	1.92	3.48	3.99	0.24	1.71	2.73	3.65	37.90
Average, Wachusett watershed,	3.40	3.58	4.33	4.91	3.01	2.00	3.92	4.50	0.15	1.88	2.97	3.89	36.54
Average, Sudbury watershed,	3.85	4.07	4.57	5.10	3.08	1.90	3.44	3.82	0.29	1.60	2.53	3.46	37.71

TABLE No. 2. — *Rainfall in Inches at Jefferson, Mass., in 1914.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1,	-	-	2.18 ²	0.46	-	-	2	-	-	-	-	-
2,	-	-	-	2	-	-	1.05	-	-	-	0.21	0.17
3,	2	-	0.24	0.14 ¹	-	2	-	2	-	-	-	-
4,	0.32	-	-	-	-	0.54	-	2	-	-	-	-
5,	-	-	-	0.12 ¹	1.35	-	-	0.06	2	-	-	-
6,	-	2	2	-	-	-	2	-	-	-	-	-
7,	-	0.42 ²	0.42 ²	2	-	-	0.57	-	-	-	-	0.78 ²
8,	-	-	-	1.23 ²	0.41	-	-	0.14	-	-	2	-
9,	-	-	-	-	-	-	0.96	-	-	-	0.27	-
10,	-	-	-	-	-	-	-	-	-	-	-	-
11,	-	-	-	-	2	-	0.31	0.43	-	-	-	-
12,	-	-	-	0.09	2	-	-	0.12	-	-	-	-
13,	-	-	-	-	1.29	-	-	-	-	-	0.10	2
14,	-	2.28 ¹	-	-	-	-	-	-	-	-	-	1.47 ²
15,	-	-	-	2	-	0.19	-	-	-	-	2	-
16,	2	0.16 ¹	-	0.97 ²	-	-	-	-	-	2	1.26	-
17,	0.09 ¹	-	-	-	-	-	-	0.60	-	1.31	-	-
18,	-	-	0.34 ²	-	-	-	0.21	0.71	-	-	-	-
19,	-	0.69 ¹	-	-	-	2	-	2	-	0.46	1.62 ²	0.21
20,	2	-	-	0.40	-	0.54	-	2	-	-	-	-
21,	1.32 ¹	-	-	-	-	-	0.25	2.52	-	-	-	0.96 ²
22,	-	-	0.07 ¹	-	-	-	-	-	-	-	-	-
23,	-	-	-	-	-	-	0.14	-	-	-	-	-
24,	0.81	-	-	-	-	-	-	-	-	-	-	0.07 ¹
25,	-	-	-	-	-	-	-	-	0.07	-	-	-
26,	0.09 ¹	-	0.10	2	0.40	-	-	-	-	-	-	-
27,	-	-	2	2	0.05	0.75	-	-	-	-	-	-
28,	-	0.50 ²	1.09 ²	1.68 ²	-	0.18	-	-	-	-	-	-
29,	-	-	-	0.27	-	-	0.53	2	-	0.16	-	0.37
30,	-	-	0.31	-	-	-	-	0.72	0.12	-	-	-
31,	0.98	-	-	-	-	-	-	-	-	-	-	-
Totals,	3.61	4.05	4.75	5.36	3.50	2.20	4.02	5.30	0.19	1.93	3.46	4.03

Total for the year 42.40 inches.

¹ Snow.² Rainfall included in that of following day.² Rain and snow.

TABLE NO. 3. — *Rainfall in Inches at Framingham, Mass., in 1914.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1,	-	-	1.49	0.26	-	0.14	2	0.11	-	-	-	-
2,	-	-	2	2	-	-	0.86	0.02	-	-	0.03	2
3,	2	2	0.20	0.14 ²	-	0.20	-	0.03	-	-	-	0.12
4,	0.17 ²	0.15	-	-	2	0.07	-	2	-	-	-	-
5,	-	-	-	0.01 ²	2	-	-	0.03	-	-	-	-
6,	-	2	2	2	1.27	-	2	-	0.01	-	-	-
7,	-	0.74 ²	0.45 ¹	2	-	-	0.60 ²	-	-	-	0.02	2
8,	0.01 ¹	-	-	1.07 ²	0.42	-	-	-	-	-	0.13	0.55 ²
9,	0.01	-	-	-	0.10	-	0.01	-	-	-	-	-
10,	-	-	-	-	-	-	-	-	-	-	-	-
11,	-	-	-	0.03	2	-	0.40	2	-	-	-	-
12,	-	-	-	-	2	-	0.06	0.29	-	-	-	-
13,	-	2	-	-	0.93	-	-	-	-	-	-	1.08
14,	-	1.70 ²	-	-	-	-	-	-	-	-	-	-
15,	0.13 ¹	-	-	2	-	2	0.03	-	-	2	2	-
16,	2	0.38 ¹	-	1.36 ²	-	0.29	-	-	-	2	0.68	-
17,	0.03 ¹	-	0.11	-	-	-	-	0.18	-	1.27	-	-
18,	-	2	0.38 ²	-	-	-	0.04	0.58	-	-	-	-
19,	-	0.52 ¹	-	-	-	0.34	-	2	-	0.19	2	0.28
20,	2	-	-	0.17	-	-	-	2	-	-	1.58 ²	-
21,	1.25 ¹	-	-	-	-	-	0.33	1.70	-	-	-	0.81 ²
22,	-	-	0.05 ¹	-	-	-	-	-	-	-	-	-
23,	-	-	0.04 ¹	-	-	-	0.09	-	-	-	-	-
24,	0.88	-	-	-	-	-	-	-	-	-	-	0.04 ¹
25,	-	-	0.05	2	0.02	-	-	-	-	-	-	-
26,	0.05 ¹	-	-	2	0.08	-	-	-	-	0.09	-	-
27,	-	-	2	1.64	-	2	2	-	-	-	-	0.01 ¹
28,	-	0.31	1.24 ²	-	-	2	0.12	-	0.01	-	-	-
29,	0.02	-	2	2	-	2	0.15	2	2	2	-	0.47
30,	-	-	0.37	0.14	-	0.98	0.02	0.56	0.16	0.01	-	-
31,	1.14	-	-	-	-	-	0.05	-	-	-	-	-
Totals, . . .	3.69	3.80	4.38	4.82	2.82	2.02	2.76	3.50	0.18	1.56	2.44	3.36

Total for the year 35.33 inches.

¹ Snow.² Rainfall included in that of following day.³ Rain and snow.

TABLE NO. 4. — *Rainfall in Inches at Chestnut Hill Reservoir in 1914.*

DATE.	Amount.	Duration.	DATE.	Amount.	Duration.
Jan. 4, .	.13	3.40 A.M. to 9.15 A.M.	Apr. 1, .	.29	3.15 P.M. to 1.25 A.M.
Jan. 4, .	.31 ¹	9.15 A.M. to 2.05 P.M.	Apr. 2, .	.30 ²	3.45 P.M. to 10.40 P.M.
Jan. 4, .	.05	2.05 P.M. to 2.20 A.M.	Apr. 2, .	.03 ²	7.25 A.M. to 5.00 P.M.
Jan. 5, .	.05 ¹	4.05 A.M. to 7.30 A.M.	Apr. 7, .	1.27 ²	3.55 A.M. to 1.50 A.M.
Jan. 7, .	.13 ¹	12.10 P.M. to 12.15 A.M.	Apr. 9, .	.05	11.00 P.M. to 3.10 A.M.
Jan. 15, .	.03 ¹	9.30 P.M. to 12.25 A.M.	Apr. 11, .	1.60 ²	6.45 P.M. to 1.30 A.M.
Jan. 16, .	.03 ¹	12.05 A.M. to 4.05 A.M.	Apr. 12, .	.23	2.30 P.M. to 1.15 A.M.
Jan. 17, .	1.07 ¹	10.15 A.M. to 4.30 P.M.	Apr. 15, .	1.77 ²	12.40 A.M. to 7.30 P.M.
Jan. 20, .	.07 ¹	8.15 A.M. to 5.55 A.M.	Apr. 17, .	.65	8.30 A.M. to 12.30 A.M.
Jan. 21, .	.86	1.30 P.M. to 5.30 P.M.	Apr. 20, .		
Jan. 21, .	.02	3.30 P.M. to 9.00 P.M.	Apr. 21, .		
Jan. 24, .	.15	5.20 A.M. to 10.00 P.M.	Apr. 26, .		
Jan. 25, .			Apr. 27, .		
Jan. 26, .			Apr. 28, .		
Jan. 29, .			Apr. 30, .		
Jan. 31, .			Total, .	6.19	
Total, .	3.96				
Feb. 3, .	.21	9.00 P.M. to 5.40 A.M.	May 4, .	1.35	8.00 P.M. to 8.00 A.M.
Feb. 4, .	.69 ²	9.40 A.M. to 5.05 A.M.	May 6, .	.49	3.30 P.M. to 3.25 A.M.
Feb. 6, .	.19	8.45 A.M. to 1.15 P.M.	May 8, .	.88	9.15 P.M. to 6.00 P.M.
Feb. 7, .	1.54 ¹	11.55 P.M. to 12.15 P.M.	May 11, .	.05	7.30 P.M. to 2.30 A.M.
Feb. 13, .	.27	12.15 P.M. to 2.45 P.M.	May 13, .		
Feb. 14, .	.06 ¹	2.45 P.M. to 8.00 P.M.	May 25, .		
Feb. 14, .	.34 ¹	9.15 A.M. to 9.15 P.M.	May 26, .		
Feb. 16, .	.74 ¹	2.20 A.M. to 12.10 A.M.	Total, .	2.77	
Feb. 19, .	.30	3.40 A.M. to 7.30 A.M.			
Feb. 20, .			June 3, .	.12	10.50 P.M. to 4.45 A.M.
Mar. 1, .			June 4, .	.06	9.15 A.M. to 8.00 P.M.
Total, .	4.34		June 4, .	.04	9.10 P.M. to 7.30 A.M.
			June 15, .	.35	1.25 A.M. to 4.25 A.M.
			June 16, .	1.16	9.00 P.M. to 9.30 A.M.
			June 20, .		
			June 27, .		
			June 30, .		
			Total, .	1.73	
Mar. 1, .	1.12	7.30 A.M. to 9.00 P.M.	July 1, .	.94	7.30 P.M. to 4.00 P.M.
Mar. 2, .	.14	3.30 P.M. to 3.00 P.M.	July 2, .	.02	1.20 P.M. to 1.30 P.M.
Mar. 3, .	.42 ¹	10.15 A.M. to 7.30 A.M.	July 5, .	1.04	2.45 P.M. to 11.00 A.M.
Mar. 6, .	.11	9.45 A.M. to 1.50 P.M.	July 6, .	.12	8.50 P.M. to 11.20 P.M.
Mar. 7, .	.42	8.10 A.M. to 2.30 P.M.	July 7, .	.03	4.50 P.M. to 5.05 P.M.
Mar. 17, .	.08 ¹	9.35 A.M. to 3.50 P.M.	July 11, .	.17	2.40 P.M. to 4.40 P.M.
Mar. 18, .	.06 ¹	3.40 P.M. to 4.35 P.M.	July 12, .	.21	7.30 A.M. to 5.30 P.M.
Mar. 22, .	.05	1.25 A.M. to 5.05 A.M.	July 21, .	.11	2.30 A.M. to 8.30 P.M.
Mar. 23, .	1.50 ²	6.00 P.M. to 1.10 A.M.	July 23, .	.04	8.30 A.M. to 1.30 P.M.
Mar. 26, .	.52	8.20 P.M. to 8.00 P.M.	July 28, .	.09	12.05 A.M. to 4.05 P.M.
Mar. 27, .			July 30, .		
Mar. 29, .			Aug. 1, .		
Mar. 29, .			Total, .	2.77	
Mar. 30, .					
Total, .	4.42				

¹ Snow.² Rain and snow.

TABLE No. 4. — *Rainfall in Inches at Chestnut Hill Reservoir in 1914* —
Concluded.

DATE.	Amount.	Duration.	DATE.	Amount.	Duration.
Aug. 3, .	.04	3.25 A.M. to 4.35 A.M.	Nov. 2, .	.04	6.30 A.M. to 7.30 A.M.
Aug. 3, .	.06	7.20 P.M. to 12.55 A.M.	Nov. 7, .	.02	4.50 P.M. to 10.00 P.M.
Aug. 4, .	.02	6.25 A.M. to 6.50 A.M.	Nov. 8, .	.24	9.00 P.M. to 2.40 A.M.
Aug. 11, .	.51	8.00 P.M. to 9.00 P.M.	Nov. 9, .	.45	5.30 P.M. to 3.00 P.M.
Aug. 12, .	.03	1.40 A.M. to 6.05 A.M.	Nov. 15, .	2.15	8.30 A.M. to 4.00 A.M.
Aug. 17, .	.08	4.30 P.M. to 8.00 P.M.	Nov. 16, .	.04	8.30 A.M. to 3.00 P.M.
Aug. 17, .	.32	8.00 P.M. to 12.10 A.M.	Nov. 19, .		
Aug. 18, .	1.00	10.50 P.M. to 4.25 A.M.	Nov. 20, .		
Aug. 19, .	.76	10.00 P.M. to 6.20 A.M.	Nov. 20, .		
Aug. 20, .	.48	8.40 A.M. to 8.30 P.M.	Total, .	2.94	
Aug. 21, .	.02	3.25 P.M. to 3.45 P.M.			
Aug. 24, .	.51	11.00 P.M. to 7.00 A.M.			
Aug. 28, .					
Aug. 30, .					
Total, .	3.83				
Sept. 3, .	.26	11.40 P.M. to 1.50 A.M.	Dec. 2, .	.21	7.15 A.M. to 7.30 P.M.
Sept. 4, .	.09	10.00 P.M. to 7.00 A.M.	Dec. 7, .	.97 ²	8.40 A.M. to 10.00 A.M.
Sept. 29, .			Dec. 8, .	1.01	7.15 P.M. to 4.20 A.M.
Sept. 30, .			Dec. 13, .	.24	2.30 P.M. to 11.40 P.M.
Total, .	0.35		Dec. 14, .	.73 ¹	6.20 A.M. to 11.30 A.M.
			Dec. 19, .	.37	11.30 A.M. to 4.30 P.M.
			Dec. 21, .	.05 ¹	3.30 P.M. to 10.30 P.M.
			Dec. 24, .	.40	4.00 A.M. to 7.30 A.M.
			Dec. 29, .		
			Dec. 30, .		
			Total, .	3.98	
Oct. 18, .	1.33	2.30 A.M. to 4.10 P.M.			
Oct. 17, .	.15	5.30 A.M. to 1.30 P.M.			
Oct. 19, .	.18	11.15 P.M. to 3.45 A.M.			
Oct. 26, .	.05	12.30 A.M. to 12.55 A.M.			
Oct. 27, .					
Oct. 30, .					
Total, .	1.71				

Total for year 38.99 inches.

¹ Snow.² Rain and snow.

TABLE NO. 5. — *Rainfall in Inches on the Wachusett Watershed,¹ 1897 to 1914.*

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1897,	3.46	2.86	4.01	2.32	5.06	5.11	8.65	3.47	1.93	0.94	7.62	6.41	51.84
1898,	6.65	3.30	2.27	4.43	3.38	3.11	3.01	10.61	3.15	7.21	6.81	3.99	57.92
1899,	2.93	5.12	6.75	1.94	1.33	5.51	3.82	3.20	4.11	2.72	1.94	2.03	41.40
1900,	4.56	8.69	6.19	2.76	4.34	3.59	3.20	3.18	3.46	2.90	6.44	3.15	52.46
1901,	1.75	1.13	5.82	9.64	7.02	1.51	5.66	4.58	3.10	3.70	2.43	9.36	55.70
1902,	2.72	4.91	5.27	4.36	2.24	2.51	3.87	3.95	4.26	6.36	0.93	7.20	48.58
1903,	2.85	4.42	6.58	3.10	1.24	10.37	3.43	3.88	2.93	4.43	2.36	3.99	49.58
1904,	4.02	2.66	3.40	7.45	2.99	3.44	3.84	3.68	5.30	1.78	1.62	2.88	43.06
1905,	6.10	1.72	3.95	2.60	0.83	4.88	5.39	3.09	6.90	1.81	2.52	3.79	43.58
1906,	2.59	2.74	5.17	3.12	6.53	5.95	5.52	4.34	2.61	3.95	2.25	4.26	49.08
1907,	2.84	2.32	1.82	2.65	2.96	3.54	3.03	1.26	9.50	5.68	5.74	4.40	45.74
1908,	3.40	4.82	2.77	2.62	5.34	1.29	3.85	6.49	1.04	2.13	1.05	3.03	37.83
1909,	3.52	6.10	4.38	5.71	2.65	3.03	4.25	3.59	3.90	1.70	1.68	3.99	44.50
1910,	5.86	5.24	1.09	3.01	2.13	4.36	1.52	3.87	2.86	1.40	4.17	2.34	37.85
1911,	2.91	2.43	3.79	2.22	1.59	2.37	2.53	5.46	3.04	5.24	4.14	3.01	38.73
1912,	2.57	2.42	5.69	4.06	5.76	0.48	2.65	2.89	2.17	2.53	4.02	4.95	40.19
1913,	3.38	2.55	5.58	3.90	3.71	0.90	2.37	3.05	4.44	6.02	2.59	2.73	41.22
1914,	3.40	3.58	4.33	4.91	3.01	2.00	3.92	4.50	0.15	1.88	2.97	3.89	38.54
Totals,	65.51	67.01	78.86	70.80	62.16	63.95	70.51	75.09	64.35	62.38	61.28	75.40	817.80
Average (18 years),	3.64	3.72	4.38	3.93	3.45	3.55	3.92	4.17	3.60	3.47	3.41	4.19	45.43

¹ Means of observations at four places, as follows: January, 1897, to December, 1900, Princeton, Jefferson, Sterling and South Clinton; January, 1901, to December, 1914, Princeton, Jefferson, Sterling and Boylston.

TABLE NO. 6. — *Rainfall in Inches on the Sudbury Watershed, 1875 to 1914.*

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1875,	2.42	3.15	3.74	3.23	3.56	6.24	3.57	5.53	3.43	4.85	4.83	0.94	45.49
1876,	1.83	4.21	7.43	4.20	2.76	2.04	9.13	1.72	4.02	2.24	5.76	3.62	49.56
1877,	3.22	0.74	8.36	3.43	3.70	2.43	2.95	3.68	0.32	8.52	5.80	0.87	44.02
1878,	5.63	5.97	4.69	5.79	0.96	3.88	2.97	6.94	1.29	6.42	7.02	6.37	57.93
1879,	2.48	3.56	5.14	4.72	1.58	3.79	3.93	6.51	1.88	0.81	2.68	4.34	41.42
1880,	3.57	3.98	3.31	3.11	1.84	2.14	6.27	4.01	1.60	3.74	1.78	2.83	38.18
1881,	5.56	4.65	5.73	2.00	3.51	5.39	2.35	1.36	2.62	2.95	4.09	3.96	44.17
1882,	5.95	4.55	2.65	1.82	5.07	1.66	1.77	1.67	8.74	2.07	1.15	2.30	39.40
1883,	2.81	3.87	1.78	1.84	4.19	2.40	2.68	0.73	1.52	5.60	1.81	3.55	32.78
1884,	5.09	6.54	4.72	4.41	3.47	3.44	3.67	4.65	0.85	2.48	2.65	5.17	47.14
1885,	4.71	3.87	1.07	3.60	3.48	2.87	1.43	7.18	1.43	5.09	6.09	2.72	43.54
1886,	6.36	6.28	3.61	2.22	3.00	1.47	3.27	4.10	2.90	3.24	4.64	4.97	46.06
1887,	5.20	4.78	4.90	4.27	1.16	2.65	3.76	5.28	-1.32	2.83	2.67	3.88	42.70
1888,	4.15	3.68	6.02	2.43	4.82	2.54	1.41	6.22	8.59	4.99	7.22	5.40	57.47
1889,	5.37	1.65	2.37	3.41	2.95	2.80	8.94	4.18	4.60	4.25	6.29	3.14	49.95
1890,	2.53	3.51	7.73	2.64	5.21	2.03	2.46	3.87	6.00	-10.51	1.20	5.31	53.00
1891,	7.02	5.23	6.48	3.91	2.01	3.77	3.39	4.73	2.38	3.83	3.09	3.68	49.52
1892,	5.85	3.14	4.06	0.83	5.58	2.76	4.23	4.44	2.84	1.17	5.80	1.13	41.83
1893,	2.92	8.20	3.67	3.60	6.61	2.38	2.57	5.41	1.74	4.07	2.20	4.86	48.23
1894,	4.09	3.91	1.43	3.42	4.24	1.15	3.26	2.03	2.63	5.34	3.43	4.81	39.74

¹ See note at end of this table.

TABLE No. 6. — *Rainfall in Inches on the Sudbury Watershed, ¹ 1875 to 1914* — Concluded.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1895,	50.62
1896,	43.70
1897,	46.19
1898,	55.88
1899,	37.21
1900,	50.65
1901,	56.11
1902,	46.07
1903,	45.16
1904,	42.82
1905,	42.31
1906,	44.48
1907,	44.38
1908,	36.15
1909,	41.75
1910,	35.64
1911,	38.38
1912,	40.72
1913,	44.31
1914,	37.71
Totals,	163.01	165.27	178.47	143.09	132.76	120.24	141.66	154.02	135.29	154.57	151.51	152.48	1,792.37
Average (40 years),	4.08	4.13	4.46	3.58	3.32	3.01	3.54	3.85	3.38	3.86	3.79	3.81	44.81

¹ Means of observations at several places, as follows: January, 1875, to March, 1876, inclusive, Lake Cochituate; April and May, 1876, Lake Cochituate, Westborough and Hopkinton; June to November, 1876, inclusive, Lake Cochituate, Southborough, Marlborough, Westborough and Hopkinton; December, 1876, to December, 1882, inclusive, Framingham, Southborough, Marlborough, Westborough and Hopkinton; January, 1883, to December, 1888, inclusive, Framingham and Westborough; January, 1890, to May, 1898, inclusive, Framingham and Ashland Dam; June, 1898, to December, 1914, inclusive, Framingham, Ashland Dam, Cordaville and Sudbury Dam.

TABLE No. 7. — *Yield of the Wachusett Watershed in Gallons per Day per Square Mile¹ from 1897 to 1914.*

MONTH.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
January,	796,000	1,563,000	2,092,000	796,000	519,000	1,676,000	1,245,000	659,000	1,266,000
February,	931,000	1,635,000	1,090,000	4,054,000	356,000	1,401,000	2,133,000	927,000	452,000
March,	2,760,000	3,088,000	2,776,000	3,722,000	2,718,000	3,992,000	3,423,000	3,008,000	3,004,000
April,	1,632,000	2,027,000	3,376,000	1,680,000	4,986,000	2,159,000	2,238,000	2,984,000	1,617,000
May,	1,163,000	1,390,000	862,000	1,382,000	2,729,000	1,031,000	569,000	1,498,000	445,000
June,	1,181,000	828,000	561,000	578,000	985,000	410,000	2,131,000	762,000	542,000
July,	1,442,000	333,000	354,000	217,000	477,000	292,000	624,000	497,000	365,000
August,	896,000	1,325,000	236,000	197,000	512,000	297,000	474,000	355,000	321,000
September,	380,000	676,000	250,000	127,000	320,000	241,000	375,000	494,000	1,228,000
October,	243,000	1,509,000	245,000	282,000	647,000	950,000	689,000	347,000	367,000
November,	1,283,000	2,170,000	430,000	875,000	517,000	635,000	634,000	343,000	442,000
December,	2,275,000	2,061,000	359,000	1,570,000	3,234,000	1,848,000	964,000	440,000	1,018,000
Average,	1,253,000	1,551,000	1,051,000	1,244,000	1,507,000	1,245,000	1,285,000	1,025,000	928,000
Average, driest six months,	886,000	1,013,000	312,000	377,000	576,000	471,000	628,000	413,000	541,000

¹ See note at end of this table.

TABLE No. 7. — *Yield of the Wachusett Watershed in Gallons per Day per Square Mile¹ from 1897 to 1914* — Concluded.

MONTH.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.	Mean for 18 Years, 1897-1914.
January,	1,132,000	1,458,000	1,738,000	592,000	1,846,000	773,000	780,000	1,414,000	960,000	1,187,000
February,	1,027,000	692,000	1,736,000	2,556,000	1,845,000	625,000	927,000	867,000	1,181,000	1,356,000
March,	1,860,000	1,697,000	2,192,000	2,129,000	2,640,000	1,339,000	2,831,000	2,263,000	3,137,000	2,699,000
April,	2,109,000	1,436,000	1,269,000	2,422,000	1,034,000	1,393,000	2,261,000	2,083,000	2,563,000	2,179,000
May,	1,533,000	965,000	1,415,000	1,212,000	608,000	461,000	1,797,000	1,038,000	1,698,000	1,211,000
June,	1,184,000	773,000	403,000	632,000	824,000	351,000	331,000	280,000	317,000	726,000
July,	728,000	335,000	220,000	233,000	62,000	57,000	135,000	19,000	329,000	373,000
August,	591,000	87,000	443,000	193,000	186,000	188,000	125,000	60,000	261,000	375,000
September,	277,000	810,000	88,000	208,000	145,000	181,000	89,000	219,000	—12,000	339,000
October,	530,000	1,382,000	158,000	90,000	68,000	718,000	145,000	678,000	136,000	510,000
November,	749,000	2,540,000	125,000	363,000	354,000	1,035,000	442,000	660,000	211,000	767,000
December,	794,000	1,961,000	387,000	537,000	391,000	1,067,000	793,000	955,000	372,000	1,168,000
Average,	1,043,000	1,180,000	847,000	918,000	828,000	682,000	891,000	879,000	984,000	1,073,000
Average, driest six months,	613,000	725,000	238,000	270,000	201,000	327,000	210,000	318,000	208,000	513,000

¹ The area of the watershed used in making up these records included water surfaces amounting to 2.2 per cent. of the whole area from 1897 to 1902 inclusive, 2.4 per cent. in 1903, 3.6 per cent. in 1904, 4.1 per cent. in 1905, 5.1 per cent. in 1906, 6.0 per cent. in 1907, 7.0 per cent. in 1908, 1909, and 1910, 6.5 per cent. in 1911, 6.8 per cent. in 1912, 6.9 per cent. in 1913 and 7.4 per cent. in 1914.

TABLE NO. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile¹ from 1875 to 1914.*

MONTH.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
January,	103,000	643,000	658,000	1,810,000	700,000	1,120,000	415,000	1,241,000	335,000	995,000	1,235,000	1,461,000	2,589,000
February,	1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000	1,546,000	2,403,000	1,033,000	2,842,000	1,354,000	4,801,000	2,829,000
March,	1,604,000	4,435,000	4,814,000	3,507,000	2,330,000	1,374,000	4,004,000	2,839,000	1,611,000	3,785,000	1,572,000	2,059,000	2,868,000
April,	3,049,000	3,292,000	2,394,000	1,626,000	3,116,000	1,169,000	1,546,000	867,000	1,350,000	2,853,000	1,815,000	1,947,000	2,620,000
May,	1,188,000	1,138,000	1,391,000	1,394,000	1,114,000	514,000	965,000	1,292,000	937,000	1,030,000	1,338,000	720,000	1,009,000
June,	870,000	222,000	597,000	506,000	413,000	175,000	1,338,000	529,000	300,000	416,000	426,000	203,000	413,000
July,	321,000	183,000	202,000	128,000	157,000	176,000	276,000	86,000	115,000	224,000	62,000	116,000	115,000
August,	396,000	405,000	121,000	476,000	395,000	119,000	148,000	55,000	79,000	257,000	240,000	94,000	214,000
September,	207,000	184,000	60,000	161,000	141,000	80,000	107,000	307,000	91,000	44,000	121,000	117,000	111,000
October,	646,000	234,000	631,000	516,000	71,000	102,000	186,000	299,000	186,000	83,000	336,000	146,000	190,000
November,	1,302,000	1,088,000	1,418,000	1,663,000	206,000	205,000	395,000	209,000	205,000	175,000	1,177,000	673,000	369,000
December,	584,000	453,000	1,290,000	3,177,000	463,000	175,000	775,000	315,000	194,000	925,000	1,174,000	1,020,000	643,000
Average,	972,000	1,135,000	1,214,000	1,452,000	894,000	578,000	979,000	862,000	533,000	1,129,000	901,000	1,087,000	1,154,000
Average, driest six months,	574,000	384,000	502,000	532,000	230,000	143,000	330,000	211,000	145,000	200,000	391,000	223,000	234,000

¹ See note at end of this table.

TABLE No. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile¹ from 1875 to 1914* — Continued.

MONTH.	1878.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
January, . . .	1,053,000	2,782,000	1,254,000	3,018,000	1,870,000	424,000	693,000	1,034,000	1,084,000	845,000	1,638,000	2,288,000	794,000	437,000
February, . . .	1,950,000	1,198,000	1,529,000	3,468,000	943,000	1,542,000	991,000	541,000	2,676,000	1,067,000	3,022,000	1,381,000	3,800,000	300,000
March, . . .	3,238,000	1,338,000	3,643,000	4,453,000	1,955,000	3,245,000	2,238,000	2,410,000	3,835,000	2,565,000	2,604,000	4,205,000	3,654,000	2,755,000
April, . . .	2,645,000	1,410,000	1,875,000	2,397,000	871,000	2,125,000	1,640,000	2,515,000	1,494,000	1,515,000	1,899,000	2,521,000	1,350,000	4,204,000
May, . . .	1,432,000	880,000	1,366,000	583,000	1,259,000	2,883,000	840,000	636,000	360,000	915,000	1,246,000	511,000	1,312,000	2,954,000
June, . . .	421,000	653,000	568,000	413,000	425,000	440,000	419,000	174,000	399,000	962,000	530,000	66,000	316,000	753,000
July, . . .	117,000	634,000	107,000	149,000	214,000	158,000	161,000	231,000	95,000	658,000	231,000	19,000	—18,000	306,000
August, . . .	379,000	1,432,000	132,000	163,000	280,000	181,000	209,000	229,000	57,000	591,000	1,107,000	—35,000	—34,000	424,000
September, . . .	1,155,000	823,000	457,000	293,000	229,000	108,000	180,000	59,000	388,000	182,000	369,000	94,000	65,000	305,000
October, . . .	1,999,000	1,230,000	2,272,000	210,000	126,000	222,000	374,000	1,379,000	592,000	94,000	1,160,000	115,000	186,000	412,000
November, . . .	2,758,000	1,941,000	1,215,000	305,000	697,000	319,000	836,000	2,777,000	659,000	909,000	1,968,000	304,000	663,000	474,000
December, . . .	3,043,000	2,241,000	996,000	544,000	485,000	796,000	716,000	1,782,000	657,000	1,584,000	1,799,000	220,000	1,096,000	2,965,000
Average, . . .	1,697,000	1,383,000	1,285,000	1,315,000	781,000	1,037,000	770,000	1,132,000	1,019,000	991,000	1,450,000	973,000	1,082,000	1,345,000
Average, driest six months, . . .	953,000	944,000	747,000	239,000	327,000	237,000	356,000	460,000	314,000	564,000	777,000	93,000	194,000	445,000

¹ See note at end of this table.

TABLE No. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile¹ from 1875 to 1914* — Concluded.

MONTH.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.	Mean for 40 Years, 1875-1914.
January, . . .	1,763,000	1,738,000	477,000	1,410,000	1,128,000	1,351,000	1,925,000	392,000	1,490,000	519,000	728,000	1,041,000	908,000	1,185,000
February, . . .	1,674,000	2,279,000	832,000	330,000	1,041,000	624,000	1,536,000	2,298,000	1,849,000	700,000	1,197,000	754,000	1,009,000	1,675,000
March, . . .	4,199,000	3,454,000	2,999,000	2,497,000	2,409,000	1,653,000	2,257,000	1,734,000	1,954,000	1,144,000	3,092,000	2,090,000	3,029,000	12,787,000
April, . . .	1,885,000	2,261,000	3,294,000	1,643,000	1,949,000	1,667,000	1,117,000	1,721,000	667,000	1,426,000	2,235,000	2,232,000	2,353,000	3,010,000
May, . . .	743,000	351,000	1,745,000	297,000	1,059,000	883,000	1,046,000	1,004,000	277,000	313,000	1,447,000	867,000	1,560,000	1,075,000
June, . . .	303,000	1,987,000	419,000	467,000	707,000	761,000	194,000	239,000	516,000	213,000	148,000	149,000	5,000	476,000
July, . . .	66,000	445,000	62,000	177,000	398,000	9,000	-14,000	-121,000	-102,000	-14,000	-77,000	-62,000	107,000	152,000
August, . . .	135,000	307,000	170,000	114,000	180,000	-104,000	102,000	-45,000	-73,000	20,000	-29,000	-54,000	156,000	225,000
September, . . .	178,000	130,000	397,000	1,246,000	19,000	541,000	-82,000	149,000	5,000	76,000	-28,000	88,000	-135,000	228,000
October, . . .	506,000	492,000	191,000	153,000	301,000	741,000	47,000	-51,000	-51,000	296,000	-14,000	494,000	-59,000	428,000
November, . . .	444,000	363,000	289,000	279,000	483,000	1,998,000	71,000	82,000	176,000	593,000	165,000	480,000	97,000	762,000
December, . . .	1,779,000	532,000	269,000	887,000	659,000	2,032,000	138,000	293,000	221,000	905,000	494,000	732,000	250,000	976,000
Average, . . .	1,140,000	1,190,000	631,000	795,000	860,000	1,010,000	694,000	625,000	570,000	514,000	779,000	733,000	772,000	965,000
Average, driest six months, . . .	271,000	338,000	228,000	403,000	341,000	471,000	44,000	40,000	29,000	151,000	26,000	180,000	29,000	376,000

¹ The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878, inclusive, and was subsequently increased by the construction of storage reservoirs to 3.0 per cent. in 1879, 3.4 per cent. in 1883, 3.9 per cent. in 1894, and 6.5 per cent. in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

NOTE. — The recorded yields, subsequent to the year 1897, are less accurate than those for previous years, particularly during months of small yield, due to unavoidable inaccuracies in the measurement of large quantities of water received from the Wachusett Reservoir.

TABLE No. 9. — *Wachusett System. — Statistics of Flow of Water, Storage and Rainfall in 1914.*

[Watershed above dam = 108.84 square miles.]

MONTH.	GALLONS PER DAY.							Rainfall (Inches).	Rainfall collected (Inches).	Percent- age of Rainfall collected.
	Discharged into Wachusett Aqueduct. ¹	Received from City of Worcester Watershed.	Wasted into River below Dam.	Seepage through the North Dike.	STORAGE. ²		Total Yield of Watershed.			
					Gain.	Loss.				
January,	103,910,000	—	2,555,000	877,000	374,000	—	107,716,000	3.40	1.765	52.0
February,	76,675,000	346,000	2,225,000	896,000	49,079,000	—	128,529,000	3.58	1.903	53.2
March,	58,003,000	23,239,000	8,771,000	958,000	296,994,000	—	341,387,000	4.33	5.595	129.1
April,	90,617,000	24,697,000	230,357,000	1,000,000	—	15,044,000	282,233,000	4.91	4.476	91.2
May,	65,200,000	19,639,000	132,500,000	1,000,000	5,894,000	—	184,945,000	3.01	3.031	100.6
June,	129,717,000	287,000	3,983,000	1,000,000	—	99,907,000	34,507,000	2.00	0.547	27.4
July,	103,813,000	1,100,000	3,684,000	971,000	—	71,520,000	35,848,000	3.92	0.588	15.0
August,	85,232,000	2,609,000	3,432,000	929,000	—	58,600,000	28,384,000	4.50	0.465	10.3
September,	114,477,000	757,000	3,493,000	903,000	—	119,396,000	—1,280,000	0.15	—0.020	—14.0
October,	120,216,000	600,000	3,690,000	858,000	—	109,348,000	14,816,000	1.88	0.243	12.9
November,	84,340,000	500,000	3,167,000	820,000	—	64,897,000	22,930,000	2.97	0.364	12.3
December,	79,071,000	404,000	3,565,000	800,000	—	42,497,000	40,535,000	3.89	0.664	17.1
Total,	—	—	—	—	—	—	—	38.54	19.621	—
Average for year,	92,603,000	6,234,000	33,415,000	918,000	—	19,022,000	101,680,000	—	—	50.9

¹ Including 183,000 gallons per day drawn from aqueduct for the supply of the Westborough State Hospital.

² Aggregate storage in Wachusett Reservoir and in ponds and mill reservoirs.

TABLE No. 10. — *Sudbury System. — Statistics of Flow of Water, Storage and Rainfall in 1914.*

[Watershed from 1875 to 1878 inclusive = 77,761 square miles; in 1879 and 1880 = 78,238 square miles; and from 1881 to 1914 inclusive = 75.2 square miles.]

MONTH.	GALLONS PER DAY.										Rain-fall collected (Inches).	Rain-fall collected (Inches).	Percentage of Rain-fall collected.
	Water received from Wachusett Reservoir. ¹	Water discharged through Sudbury Aqueduct.	Water discharged through Western Aqueduct.	Water used by Framingham Water Works.	Water diverted from Watershed by Sewers, etc.	Water wasted into River below Lowest Dam.	STORAGE.		Total Yield of Watershed.				
							Gain.	Loss.					
January, . .	103,729,000	86,529,000	39,222,000	968,000	1,381,000	40,258,000	3,642,000	-	68,271,000	3.85	1.619	42.1	
February, . .	76,496,000	82,343,000	38,486,000	1,036,000	1,510,000	66,925,000	-	37,943,000	75,861,000	4.07	1.625	39.9	
March, . .	57,826,000	72,555,000	37,455,000	877,000	2,194,000	129,184,000	43,335,000	-	227,774,000	4.57	5.404	118.1	
April, . .	90,430,000	66,557,000	36,750,000	737,000	2,473,000	151,686,000	9,157,000	-	176,930,000	5.10	4.061	79.6	
May, . .	65,016,000	61,748,000	37,797,000	771,000	2,000,000	91,145,000	-	11,897,000	116,548,000	3.08	2.765	89.7	
June, . .	129,527,000	71,947,000	38,180,000	863,000	974,000	4,043,000	13,860,000	-	340,000	1.90	0.008	0.4	
July, . .	103,620,000	68,023,000	37,452,000	742,000	868,000	4,555,000	-	10,000	8,010,000	3.44	0.190	5.5	
August, . .	85,045,000	66,987,000	37,152,000	703,000	864,000	5,616,000	-	14,571,000	11,706,000	3.82	0.277	7.3	
September, . .	114,333,000	71,427,000	37,253,000	747,000	866,000	1,876,000	-	8,023,000	-10,187,000	0.29	-0.234	-8.0	
October, . .	120,019,000	65,619,000	37,387,000	729,000	784,000	1,500,000	9,565,000	-	-4,435,000	1.60	-0.105	-6.6	
November, . .	84,150,000	60,340,000	37,143,000	723,000	820,000	5,414,000	-	12,963,000	7,327,000	2.53	0.168	6.7	
December, . .	78,897,000	65,600,000	37,478,000	797,000	810,000	7,290,000	-	14,294,000	18,794,000	3.46	0.446	12.9	
Total, . .	-	-	-	-	-	-	-	-	-	37.71	16.224	-	
Av. for year, . .	92,420,000	69,898,000	37,643,000	807,000	1,294,000	42,273,000	-	1,404,000	58,091,000	-	-	43.0	

¹ Not including 183,000 gallons per day drawn from the Wachusett Aqueduct for the supply of the Westborough State Hospital, which were not discharged into Sudbury Reservoir.

TABLE No. 11. — *Cochituate System. — Statistics of Flow of Water, Storage and Rainfall in 1914.*[Watershed of lake = 17.58 square miles.¹]

MONTH.	GALLONS PER DAY.							Rainfall collected (Inches).	Rainfall collected (Inches).	Percent- age of Rainfall collected.
	Water received from External Sources. 2	Water discharged through Cochituate Aqueduct.	Water di- verted from Watershed by Sewers, etc.	Water wasted at Outlet of Lake.	STORAGE.		Total Yield of Watershed.			
					Gain.	Loss.				
January,	12,674	—	742,000	31,616,000	—	1,894,000	17,760,000	3.53	1.80	51.1
February,	—	—	818,000	33,818,000	—	15,632,000	18,504,000	4.11	1.70	41.3
March,	7,361	—	1,326,000	46,348,000	14,574,000	—	54,887,000	4.41	5.57	126.3
April,	7,687	—	2,123,000	40,267,000	3,847,000	—	38,540,000	4.93	3.78	76.8
May,	—	—	1,845,000	20,110,000	3,135,000	—	25,090,000	2.71	2.55	94.0
June,	—	—	750,000	520,000	1,187,000	—	2,457,000	1.59	0.24	15.2
July,	—	—	635,000	2,726,000	—	229,000	3,132,000	3.17	0.32	10.0
August,	—	—	539,000	1,361,000	461,000	—	2,361,000	3.62	0.24	6.6
September,	—	—	463,000	—	—	2,140,000	—1,677,000	0.27	—0.16	—6.1
October,	—	—	416,000	—	—	77,000	339,000	1.69	0.03	2.0
November,	—	—	430,000	9,820,000	—	6,637,000	3,623,000	2.45	0.35	14.5
December,	—	—	374,000	10,000,000	—	4,210,000	6,164,000	3.38	0.63	18.5
Total,	—	—	—	—	—	—	—	35.86	17.05	—
Average for year,	2,334,000	—	873,000	16,241,000	—	508,000	14,272,000	—	—	47.5

¹ Not including the watersheds of Dudley and Dug ponds.² From Framingham Reservoirs, Nos. 1, 2 and 3.

TABLE NO. 12. — *Elevations of Water Surfaces of Reservoirs above Boston City Base at the Beginning of Each Month.*

DATE.	Chestnut Hill Reservoir. Ordinary High Water = 134.00.	Lake Cochituate. High Water = 144.36.	Farm Pond. High Water = 159.25.	Spot Pond. High Water = 163.00.	Weston Reservoir. High Water = 200.00.	FRAMINGHAM RESERVOIR.			Ashland Reservoir. Flash Boards 225.23.	Sudbury Reservoir. Flash Boards 259.97.	Hopkinton Reservoir. Flash Boards 305.00.	Whitehall Reservoir. Ordinary High Water = 337.91.	Wachusett Reservoir. Ordinary High Water = 395.00.
						No. 1.	No. 2.	No. 3.					
Jan. 1, 1914.	133.92	143.51	158.46	163.00	199.99	167.80	177.33	183.00	225.13	258.75	304.81	337.60	387.48
Feb. 1, 1914.	133.82	143.26	158.64	162.90	200.11	168.29	177.72	183.43	224.79	259.07	304.59	337.24	387.47
Mar. 1, 1914.	133.95	141.36	158.72	162.59	199.95	167.96	176.26	183.04	222.29	257.74	301.91	336.87	388.59
April 1, 1914.	133.60	143.32	158.69	162.89	200.01	168.18	176.46	186.12	224.80	259.22	304.53	337.57	395.43
May 1, 1914.	133.82	143.81	158.62	163.37	200.02	168.34	176.36	186.31	224.74	259.83	304.41	337.65	395.10
June 1, 1914.	134.15	144.22	158.42	162.73	199.96	167.72	177.23	184.41	225.41	259.09	304.97	337.76	395.35
July 1, 1914.	133.91	144.37	158.01	162.61	200.11	169.37	177.19	185.01	225.20	259.98	304.88	337.56	393.26
Aug. 1, 1914.	133.69	144.34	157.71	162.77	199.94	169.40	177.23	185.04	225.21	259.98	304.87	337.61	391.59
Sept. 1, 1914.	133.78	144.40	157.58	162.87	199.99	169.34	177.17	184.06	225.28	259.05	304.97	337.70	390.21
Oct. 1, 1914.	134.05	144.13	157.18	162.82	199.96	169.01	177.14	184.11	224.96	258.81	304.56	337.37	387.51
Nov. 1, 1914.	133.91	144.12	157.02	162.85	200.06	169.13	177.14	184.19	224.95	259.60	304.17	337.31	384.78
Dec. 1, 1914.	133.85	143.25	158.79	162.91	199.99	167.65	175.95	184.09	224.30	258.79	304.02	337.45	383.09
Jan. 1, 1915.	133.92	142.62	158.66	162.55	200.00	167.66	175.98	183.03	224.34	257.81	304.05	337.66	381.89

TABLE NO. 13. — *Sources from which and Periods during which Water has been drawn for the Supply of the Metropolitan Water District.**From Wachusett Reservoir into the Wachusett Aqueduct.*

MONTH.	Number of Days during which Water was flowing.	ACTUAL TIME.		Million Gallons drawn.
		Hours.	Minutes.	
January,	24	287	—	3,221.2
February,	22	233	50	2,146.9
March,	25	204	—	1,798.1
April,	26	282	—	2,718.5
May,	27	265	30	2,021.2
June,	24	330	55	3,891.5
July,	24	284	35	3,218.2
August,	26	264	52	2,642.2
September,	20	270	47	3,434.3
October,	26	314	25	3,726.7
November,	22	202	25	2,530.2
December,	25	239	32	2,451.2
Totals,	291	3,179	51	33,800.2

Total actual time, 132.50 days.

Total quantity drawn, 33,800,200,000 gallons.

From Sudbury Reservoir through the Weston Aqueduct to Weston Reservoir.

MONTH.	Number of Days during which Water was flowing.	Actual Time (Hours).	Million Gallons drawn.
January,	31	744	1,215.9
February,	28	672	1,077.6
March,	31	744	1,161.1
April,	30	720	1,102.5
May,	31	744	1,171.7
June,	30	720	1,145.4
July,	31	744	1,161.0
August,	31	744	1,151.7
September,	30	720	1,117.6
October,	31	744	1,159.0
November,	30	720	1,114.3
December,	31	744	1,161.8
Totals,	365	8,760	13,739.6

Total actual time, 365 days.

Total quantity drawn, 13,739,100,000 gallons.

TABLE No. 13 — *Concluded.*

From Framingham Reservoir No. 3 through the Sudbury Aqueduct to Chestnut Hill Reservoir.

MONTH.	Number of Days during which Water was flowing.	Actual Time (Hours).	Million Gallons drawn.
January,	31	744	2,289.5
February,	28	672	2,305.6
March,	31	744	2,021.0
April,	30	720	1,766.1
May,	31	744	1,914.2
June,	30	720	2,158.4
July,	30	744	2,108.7
August,	31	744	2,076.6
September,	30	720	2,142.8
October,	31	744	2,034.2
November,	30	712	1,810.2
December,	31	744	2,033.6
Totals,	365	8,752	24,660.9

Total actual time, 364.33 days.
Total quantity drawn, 24,660,900,000 gallons.

TABLE No. 14. — *Average Daily Quantity of Water flowing through Aqueducts in 1914 by Months.¹*

MONTH.	Wachusett Aqueduct into Sudbury Reservoir (Gallons).	Weston Aqueduct into Metropolitan District (Gallons).	Sudbury Aqueduct into Chestnut Hill Reservoir (Gallons).	Cochituate Aqueduct into Chestnut Hill Reservoir (Gallons).
January,	103,729,000	39,223,000	73,855,000	-
February,	76,496,000	38,486,000	82,343,000	-
March,	57,826,000	37,455,000	65,194,000	-
April,	90,430,000	36,750,000	58,870,000	-
May,	65,016,000	37,797,000	61,748,000	-
June,	129,527,000	38,180,000	71,947,000	-
July,	103,620,000	37,452,000	68,023,000	-
August,	85,045,000	37,152,000	66,987,000	-
September,	114,333,000	37,253,000	71,427,000	-
October,	120,019,000	37,387,000	65,619,000	-
November,	84,150,000	37,143,000	60,340,000	-
December,	78,887,000	37,478,000	65,600,000	-
Average,	92,420,000	37,643,000	67,564,000	-

¹ Not including quantities wasted while cleaning and repairing aqueducts.

TABLE No. 15. — *Statement of Operation of Engines Nos. 1 and 2 at Chestnut Hill Pumping Station No. 1 for the Year 1914.*

[3 per cent. allowed for slip.]

MONTH.	ENGINE NO. 1.		ENGINE NO. 2.		Total Quantity pumped (Million Gallons).	Total Coal consumed (Pounds).	Total Ashes and Clinker (Pounds).	Per cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal; no Deduction for Heating or Lighting.	AVERAGE LEAK (FEET).		Duty in Root-pounds per 100 Pounds of Coal, corrected for Slip; no Deduction for Heating or Lighting.	Duty in Root-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.
	Total Pumping Time.	Quantity pumped, corrected for Slip (Million Gallons).	Total Pumping Time.	Quantity pumped, corrected for Slip (Million Gallons).						Engine No. 1.	Engine No. 2.		
January,	Hrs. Min. 345 25	113.57	Hrs. Min. 33 20	10.46	124.03	246,225	23,535	9.6	503.73	132.76	132.84	55,710,000	57,440,000
February,	141 50	46.21	-	-	46.21	141,310	16,050	11.4	327.01	133.02	-	36,230,000	37,360,000
March,	125 05	40.54	-	-	40.54	119,080	13,680	11.5	340.44	133.29	-	37,800,000	38,980,000
April,	13 30	4.22	-	-	4.22	58,395	9,720	16.6	72.27	125.30	-	7,540,000	7,770,000
May,	33 55	11.81	-	-	11.81	50,810	7,790	15.3	232.43	131.50	-	25,460,000	26,250,000
June,	140 50	48.13	-	-	48.13	123,545	14,750	11.9	389.57	134.13	-	43,530,000	44,880,000
July,	120 50	43.39	-	-	43.39	125,500	17,555	14.0	345.74	134.15	-	38,640,000	39,840,000
August,	-	-	-	-	-	13,620	1,634	12.0	-	-	-	-	-
September,	16 10	5.60	-	-	5.60	23,105	3,605	15.6	242.37	133.61	-	26,980,000	27,820,000
October,	-	-	-	-	-	17,130	3,575	20.9	-	-	-	-	-
November,	-	-	-	-	-	34,355	4,960	14.4	-	-	-	-	-
December,	123 40	43.10	-	-	43.10	118,060	11,574	9.8	365.07	133.09	-	40,470,000	41,730,000
Total,	1,061 15	356.57	33 20	10.46	367.03	1,071,135	128,478	-	-	-	-	-	-
Average,	-	-	-	-	-	-	-	12.0	342.66	133.13	132.84	38,000,000	39,180,000

TABLE No. 16. — Statement of Operation of Engine No. 3 at Chestnut Hill Pumping Station No. 1 for the Year 1914.

MONTH.	Total Pumping Time.	Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal; no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, corrected for Slip; no Deduction for Heating or Lighting.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.
January,	Hrs. Min.								
February,	30	.25	310	500	5.2	1,026.80	116.08	99,290,000	103,850,000
March,	12 00	9.96	9,700			865.02	120.30	86,680,000	90,680,000
April,	6 30	4.71	5,445						
May,	-	-	-						
June,	-	-	-						
July,	-	-	-						
August,	-	-	-						
September,	-	-	-						
October,	-	-	-						
November,	-	-	-						
December,	-	-	-						
Total,	19 00	14.92	15,455						
Average,	-	-	-						
								94,430,000	98,760,000

TABLE No. 17. — Statement of Operation of Engine No. 4 at Chestnut Hill Pumping Station No. 1 for the Year 1914.

[2 per cent. allowed for slip.]

MONTH.	Total Pumping Time.	Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal; no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, corrected for Slip; no Deduction for Heating or Lighting.	Duty in Foot-pounds on Basis of Plunger Displacement; no Deduction for Heating or Lighting.	SUMMARY OF ENGINES Nos. 1, 2, 3 AND 4.	
										Total Quantity pumped, corrected for Slip (Million Gallons).	Daily Average Quantity pumped (Million Gallons).
January,	Hrs. Min.	806.92	568,125	66,270	11.7	1,420.32	119.49	141,370,000	144,210,000	931.20	30.039
February,	630 00	—	—	—	—	—	—	—	—	56.17	2.006
March,	—	—	—	—	—	—	—	—	—	45.25	1.460
April,	—	—	—	—	—	—	—	—	—	4.22	.141
May,	—	—	—	—	—	—	—	—	—	11.81	.381
June,	—	—	—	—	—	—	—	—	—	48.13	1.604
July,	—	—	—	—	—	—	—	—	—	43.39	1.400
August,	—	—	—	—	—	—	—	—	—	—	—
September,	—	—	—	—	—	—	—	—	—	5.60	.187
October,	—	—	—	—	—	—	—	—	—	—	—
November,	—	—	—	—	—	—	—	—	—	—	—
December,	250 30	321.69	222,510	25,905	11.6	1,445.73	119.96	144,470,000	147,370,000	364.79	11.767
Total,	880 30	1,128.61	790,635	92,175	—	—	—	142,240,000	—	1,510.56	—
Average,	—	—	—	—	11.7	1,427.47	119.62	145,100,000	—	—	4.139

TABLE No. 18. — Statement of Operation of Engines Nos. 5, 6 and 7 at Chestnut Hill Pumping Station No. 2 for the Year 1914.
[2 per cent. allowed for slip.]

MONTH.	ENGINE No. 5.		ENGINE No. 6.		ENGINE No. 7.		Total Quantity pumped (Million Gallons).	Daily Average Quantity pumped (Million Gallons).	Total Coal consumed (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Round of Coal; no Deduction for Heating or Lighting.	AVERAGE LIFT (Feet).			Duty in Foot-Pounds per 100 Pounds of Coal, corrected for Heating or Lighting.	Duty in Foot-Pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.
	Total Pumping Time.	Quantity pumped, corrected for Slip (Million Gallons).	Total Pumping Time.	Quantity pumped, corrected for Slip (Million Gallons).	Total Pumping Time.	Quantity pumped, corrected for Slip (Million Gallons).						Engine No. 5.	Engine No. 6.	Engine No. 7.		
January, . . .	744 00	923.08	8 45	8.50	316 45	279.23	1,210.91	39.068	480,335	12.5	2,520.76	40.74	35.99	32.63	81,550,000	83,220,000
February, . . .	668 00	844.75	29 35	37.04	478 25	420.52	1,302.31	46.511	477,790	10.7	2,725.75	42.28	43.73	32.66	89,640,000	90,870,000
March, . . .	738 10	890.22	6 20	7.74	292 00	233.98	1,131.94	36.514	401,335	11.8	2,820.44	39.92	43.22	32.25	90,120,000	91,970,000
April, . . .	481 45	664.14	239 30	312.00	-	-	976.14	32.538	324,520	12.3	3,007.95	40.14	40.74	-	101,060,000	103,130,000
May, . . .	306 15	385.51	477 55	575.66	4 50	2.36	963.53	31.082	327,815	12.3	2,939.25	44.41	39.37	32.83	101,290,000	103,370,000
June, . . .	719 00	977.14	1 25	1.68	259 55	213.41	1,192.23	39.741	379,945	12.2	3,137.90	44.62	44.20	32.54	110,980,000	113,260,000
July, . . .	703 05	878.66	49 45	58.76	248 10	196.01	1,123.43	36.240	367,700	12.8	3,055.29	42.77	43.63	32.46	104,620,000	106,760,000
August, . . .	718 05	869.70	71 20	78.29	194 35	153.38	1,101.37	35.528	361,395	13.5	3,047.55	41.60	43.49	32.78	102,830,000	104,940,000
September, . . .	720 00	917.26	-	-	260 30	216.09	1,133.35	37.778	371,745	11.9	3,048.73	42.45	-	32.31	102,900,000	105,010,000
October, . . .	720 05	855.10	24 30	26.79	236 25	187.04	1,068.93	34.482	350,145	12.5	3,032.82	41.46	40.90	32.24	101,290,000	103,370,000
November, . . .	685 30	763.46	190 25	193.30	-	-	956.76	31.892	329,020	13.4	2,907.91	39.26	41.76	-	96,320,000	98,290,000
December, . . .	285 00	313.86	8 40	7.85	579 20	745.24	1,066.95	34.418	407,905	12.7	2,615.68	41.70	40.02	39.39	87,320,000	89,110,000
Total, . . .	7,488 55	9,282.88	1,108 10	1,307.61	2,870 55	2,637.26	13,227.75	-	4,579,640	-	-	-	-	-	-	-
Average, . . .	-	-	-	-	-	-	-	36.240	-	12.3	2,888.38	41.74	40.65	34.45	96,670,000	98,650,000

TABLE No. 19. — *Statement of Operation of Engine No. 12 at Chestnut Hill Pumping Station No. 2 for the Year 1914.*

MONTH.		[2 per cent. allowed for slip.]									
		Total Pumping Time.		Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal; no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Foot-pounds corrected for Heating or Lighting.	Duty in Foot-pounds on Basis of Plunger Displacement; no Deduction for Heating or Lighting.
		Hrs.	Min.								
January,	.	128	15	166.30	117,890	13,830	11.7	1,410.64	121.21	142,430,000	145,320,000
February,	.	671	15	961.76	611,715	68,285	11.2	1,572.24	120.37	157,650,000	160,850,000
March,	.	738	05	970.45	628,465	76,165	12.1	1,544.16	119.39	153,570,000	156,690,000
April,	.	716	30	963.94	632,785	77,620	12.3	1,523.33	121.87	154,640,000	157,780,000
May,	.	738	20	1,036.97	681,430	83,520	12.3	1,521.76	122.07	154,740,000	157,880,000
June,	.	718	45	1,025.99	686,530	88,155	12.8	1,494.46	121.70	151,500,000	154,580,000
July,	.	740	20	991.02	673,360	89,380	13.3	1,471.75	121.00	148,340,000	151,350,000
August,	.	744	00	1,023.87	698,665	94,065	13.5	1,465.47	122.98	150,130,000	153,180,000
September,	.	716	50	1,025.78	695,045	87,985	12.7	1,475.85	124.41	152,960,000	156,050,000
October,	.	740	25	1,018.65	706,620	92,420	13.1	1,441.58	124.07	148,990,000	152,010,000
November,	.	717	45	935.84	635,955	88,370	13.9	1,471.55	123.81	151,770,000	154,850,000
December,	.	499	35	665.73	430,000	56,650	13.2	1,548.21	123.65	159,470,000	162,710,000
Total,	.	7,870	05	10,786.30	7,198,460	916,445	-	-	-	-	-
Average,	.	-	-	-	-	-	12.7	1,498.42	122.26	152,600,000	155,700,000

TABLE No. 20. — Statement of Operation of Engine No. 8 at Spot Pond Pumping Station for the Year 1914.

[2 per cent. allowed for slip.]

MONTH.	Total Pumping Time.	Quantity pumped, corrected for slip (Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal; no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, corrected for Slip; no Deduction for Heating or Lighting.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.
January,	Hrs. Min.								
February,									
March,	10 30	4.68	5,445	750	13.8	859.50	127.88	91,540,000	93,430,000
April,									
May,									
June,	193 00	83.00	85,661	11,745	13.7	968.94	126.90	102,420,000	104,530,000
July,									
August,									
September,									
October,									
November,	9 30	4.10	4,410	540	12.2	926.71	111.17	86,100,000	87,870,000
December,									
Total,	213 00	91.78	95,516	13,035					
Average,					13.6	960.89	126.25	101,050,000	103,130,000

TABLE No. 21. — Statement of Operation of Engine No. 9 at Spot Pond Pumping Station for the Year 1914.
[2 per cent. allowed for slip.]

MONTH.	Total Pumping Time.		Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal; no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Root-pounds per 100 Pounds of Coal, corrected for Heating or Lighting.	Duty in Root-pounds per 100 Pounds of Coal, corrected for Heating or Lighting.	SUMMARY OF ENGINES Nos. 8 and 9.	
											Total Quantity pumped, corrected for Slip (Million Gallons).	Daily Average Quantity pumped (Million Gallons).
January,	Hrs. Min.	245 30	201.91	177,103	20,531	11.6	1,140.07	127.27	120,870,000	123,320,000	201.91	6.513
February,	234 30	194.15	168,169	19,475	19,475	11.6	1,154.49	127.44	122,560,000	126,060,000	194.15	6.934
March,	280 45	213.39	197,953	24,962	24,962	12.6	1,077.98	137.24	123,240,000	126,740,000	213.39	7.035
April,	251 40	209.05	201,182	24,796	24,796	12.3	1,039.11	137.25	118,900,000	121,210,000	209.05	6.968
May,	285 35	236.16	218,457	26,019	26,019	11.9	1,081.04	136.74	123,140,000	125,640,000	236.16	7.618
June,	246 05	202.76	172,567	22,173	22,173	12.8	1,174.96	134.07	131,220,000	133,880,000	202.76	9.525
July,	311 00	255.89	228,959	29,470	29,470	12.9	1,117.62	134.87	125,560,000	128,110,000	255.89	8.255
August,	297 50	249.12	224,240	25,665	25,665	11.4	1,110.95	135.31	125,220,000	127,760,000	249.12	8.036
September,	276 40	232.28	198,317	23,589	23,589	11.9	1,171.26	128.67	125,540,000	128,090,000	232.28	7.743
October,	253 15	209.51	183,877	22,840	22,840	12.4	1,139.40	127.62	121,130,000	123,590,000	209.51	6.758
November,	227 30	189.75	167,632	21,000	21,000	12.5	1,131.94	128.04	120,730,000	123,180,000	189.75	6.462
December,	243 10	203.13	179,094	23,145	23,145	12.9	1,134.78	127.42	120,450,000	122,900,000	203.13	6.553
Total,	3,133 30	2,597.10	2,317,460	283,665	283,665	-	-	-	-	-	2,688.88	-
Average,	-	-	-	-	-	12.2	1,120.67	132.04	123,290,000	125,760,000	-	7.367

TABLE No. 22. — Statement of Operation of Engine No. 10 at Arlington Pumping Station for the Year 1914.

[2 per cent. allowed for slip.]

MONTH.	Total Pumping Time.		Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal; no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Root-pounds per 100 Pounds of Coal, corrected for Heating or Lighting.	Duty in Root-pounds per 100 Pounds of Coal, Displacement; no Deduction for Heating or Lighting.
	Hrs.	Min.								
January,	374	30	15.08	58,890	5,483	9.3	256.07	285.15	60,820,000	61,870,000
February,	338	45	14.19	57,665	5,221	9.1	246.08	285.57	58,540,000	59,550,000
March,	431	30	18.70	73,580	6,532	8.9	254.15	284.05	60,140,000	61,180,000
April,	432	00	18.72	68,760	5,248	7.6	272.25	278.73	63,210,000	64,300,000
May,	507	15	23.73	81,660	6,725	8.2	290.60	281.21	68,070,000	69,250,000
June,	588	00	30.65	99,966	7,981	8.0	306.60	285.78	72,990,000	74,250,000
July,	515	00	23.98	83,065	6,789	8.2	288.69	281.47	67,690,000	68,860,000
August,	444	15	20.67	75,530	6,591	8.7	273.67	281.55	64,180,000	65,290,000
September,	535	45	25.71	92,265	8,311	9.0	276.65	282.83	65,650,000	66,790,000
October,	411	30	19.79	81,227	8,619	10.6	243.64	280.00	56,830,000	57,810,000
November,	278	30	11.18	52,296	5,568	10.6	213.79	277.64	49,440,000	50,300,000
December,	492	45	19.49	86,955	8,408	9.7	224.14	278.45	51,990,000	52,890,000
Total,	5,349	45	241.89	911,858	81,476	-	-	-	-	-
Average,	-	-	-	-	-	8.9	265.27	282.06	62,330,000	63,410,000

TABLE No. 23. — Statement of Operation of Engine No. 11 at Arlington Pumping Station for the Year 1914.
(4 per cent. allowed for slip.)

MONTH.	Total Pumping Time.		Quantity pumped, corrected for Slip (Million Gallons).	Coal consumed (Pounds).	Ashes and Clinker (Pounds).	Per Cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal; no Deduction for Heating or Lighting.	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, corrected for Slip; no Deduction for Heating or Lighting.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement; no Deduction for Heating or Lighting.	SUMMARY OF ENGINES Nos. 10 AND 11.	
											Total Quantity pumped, corrected for Slip (Million Gallons).	Daily Average Quantity pumped (Million Gallons).
January,	137	30	3.54	25,060	1,939	7.7	141.26	283.54	33,360,000	34,910,000	18.62	.601
February,	139	00	3.68	25,310	1,928	7.6	145.40	281.36	34,080,000	35,680,000	17.87	.638
March,	-	-	-	-	-	-	-	-	-	-	18.70	.603
April,	-	-	-	-	-	-	-	-	-	-	18.72	.624
May,	-	-	-	-	-	-	-	-	-	-	23.73	.765
June,	-	-	-	-	-	-	-	-	-	-	30.65	1.022
July,	-	-	-	-	-	-	-	-	-	-	23.98	.774
August,	46	30	1.51	8,930	637	7.1	169.09	276.67	38,970,000	40,780,000	22.18	.716
September,	-	-	-	-	-	-	-	-	-	-	25.71	.857
October,	120	15	3.35	24,625	2,447	9.9	136.04	277.46	31,440,000	32,900,000	23.14	.746
November,	230	45	8.03	53,970	5,560	10.3	148.79	277.07	34,570,000	36,180,000	19.21	.640
December,	-	-	-	-	-	-	-	-	-	-	19.49	.629
Total,	734	00	20.11	137,995	12,511	-	-	-	-	-	262.00	-
Average,	-	-	-	-	-	9.1	145.84	279.03	33,900,000	35,480,000	-	.718

TABLE No. 24. — Statement of Operation of Engines Nos. 13 and 14 at Hyde Park Pumping Station for the Year 1914.

[2 per cent. allowed for slip.]

MONTH.	ENGINE No. 13.		ENGINE No. 14.		Total Quantity pumped (Million Gallons).	Total coal consumed (Pounds).	Total Ashes and Clinker (Pounds).	Per cent. of Ashes and Clinker.	Gallons pumped per Pound of Coal; no Deduction for Heating or Lighting.	AVERAGE LIFT (Feet).		Duty in Root-pounds per 100 Pounds of Coal, corrected for Slip; no Deduction for Heating or Lighting.	Duty in Root-pounds on Basis of Plunger Displacement; no Deduction for Heating or Lighting.
	Hrs. Min.	Quantity pumped, corrected for Slip (Million Gallons).	Total Pumping Time.	Quantity pumped, corrected for Slip (Million Gallons).						Engine No. 13.	Engine No. 14.		
January.	252 45	7.97	339 25	11.92	19.89	51,774	8,494	16.4	384.17	118.08	120.49	38,260,000	39,080,000
February.	283 15	9.64	255 25	9.14	18.78	41,700	5,725	13.7	450.36	123.20	121.04	45,830,000	46,820,000
March.	255 15	8.81	330 50	11.45	20.26	42,086	5,578	13.3	481.40	119.52	119.74	47,970,000	49,000,000
April.	191 10	6.59	381 25	12.95	19.54	39,484	5,669	14.4	494.88	120.07	119.43	49,330,000	50,390,000
May.	462 35	17.01	130 35	5.54	22.55	40,948	5,599	13.7	550.70	119.99	121.88	55,260,000	56,460,000
June.	-	-	583 30	26.70	26.70	43,755	5,447	12.4	610.22	-	123.49	62,770,000	64,120,000
July.	22 00	1.03	574 30	21.00	22.03	41,580	5,710	13.7	530.08	119.90	119.25	52,660,000	53,790,000
August.	4 15	.16	587 45	21.63	21.79	42,054	5,659	13.5	518.14	115.50	119.36	51,510,000	52,620,000
September.	-	-	571 25	22.66	22.66	42,340	5,594	13.2	535.19	-	120.13	53,560,000	54,710,000
October.	129 50	5.07	453 30	17.56	22.63	42,008	5,229	12.4	538.71	121.86	120.77	54,300,000	55,470,000
November.	-	-	546 45	19.60	19.60	39,186	4,637	11.8	500.18	-	121.06	50,440,000	51,520,000
December.	3 00	.18	554 25	19.06	19.24	41,531	5,427	13.1	463.27	127.20	121.29	46,810,000	47,820,000
Total.	1,604 05	56.46	5,309 30	199.21	255.67	508,426	68,768	-	-	-	-	-	-
Average.	-	-	-	-	-	-	-	13.5	502.87	120.38	120.71	50,530,000	51,620,000

TABLE No. 25. — (Meter Basis.) Average Daily Consumption of Water by Districts in the Cities and Towns supplied by the Metropolitan Water Works in 1914. (For Consumption of Water in Whole Metropolitan Water District, see Table No. 27.)

MONTH.	SOUTHERN LOW SERVICE.	NORTHERN LOW SERVICE.	SOUTHERN HIGH SERVICE.	NORTHERN HIGH SERVICE.	SOUTHERN EXTRA HIGH SERVICE.	NORTHERN EXTRA HIGH SERVICE.	Total District supplied (Gallons).	Estimated Population.	Consumption per Inhabitant (Gallons).
	Boston, excluding East Boston and Charlestown (Gallons).	Portions of Charlestown, Somerville, Chelsea, Everett, Malden, Medford, East Boston and Arlington (Gallons).	Quincy, Watertown, and Portions of Boston, Belmont and Milton (Gallons).	Revere, Winthrop, Swampscott, Nahant, Stoneham, Melrose, and Portions of Boston, Chelsea, Everett, Malden, Medford and Somerville (Gallons).	Portions of Boston and Milton (Gallons).	Lexington and Portions of Arlington and Belmont (Gallons).			
January,	50,091,000	22,301,800	31,842,100	7,141,300	659,300	600,700	112,636,200	1,122,000	100
February,	54,739,300	24,915,300	33,561,600	7,537,400	691,700	638,300	122,083,600	1,124,030	109
March,	45,668,900	20,535,800	29,634,600	6,802,800	685,000	603,300	103,880,400	1,126,060	92
April,	41,392,000	19,346,500	29,793,500	6,811,700	681,900	645,500	98,671,100	1,128,090	87
May,	41,545,800	19,639,200	33,155,900	7,447,100	769,000	775,500	103,332,500	1,130,120	91
June,	44,038,300	21,332,600	34,602,000	9,095,200	983,200	1,041,200	111,072,500	1,132,150	98
July,	44,238,400	19,854,200	32,530,800	8,093,600	762,900	774,900	106,254,800	1,134,180	94
August,	44,706,700	19,583,100	32,350,000	8,002,400	755,700	711,100	106,112,000	1,136,210	93
September,	45,346,400	20,275,100	33,660,200	8,152,000	815,700	867,000	109,116,400	1,138,240	96
October,	44,106,300	19,174,300	32,196,900	7,361,400	793,700	750,900	104,383,500	1,140,270	91
November,	42,659,500	18,384,100	30,542,000	6,916,400	702,900	655,600	99,860,500	1,142,310	87
December,	46,352,700	20,913,300	32,479,700	7,099,100	663,800	623,000	108,131,600	1,144,340	95
For the year,	45,353,100	20,492,500	32,185,200	7,536,200	745,400	723,700	107,036,100	1,134,180	94

In addition to the above quantities Wakefield was supplied with 111,433,000 gallons, equivalent to a daily average rate of 305,300 gallons, the United States Government Reservation on Peabody's Island with 39,800,000 gallons, equivalent to a daily average rate of 109,000 gallons, and a part of Saugus with 5,002,200 gallons, equivalent to a daily average rate of 13,700 gallons.

TABLE No. 26. — (Meter Basis.) *Average Daily Consumption of Water in Cities and Towns supplied from Metropolitan Works in 1914.*

City or town,	BOSTON.		SOMERVILLE.		MALDEN.		CHELSEA.		EVERETT.		QUINCY.		MEDFORD.	
	747,530.		84,530.		48,850.		35,910.		38,560.		36,410.		26,490.	
MONTH.	GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.	
	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January,	87,328,400	118	6,811,000	81	2,365,000	49	2,967,000	82	3,003,500	79	2,435,400	68	1,272,800	49
February,	94,850,400	128	7,435,900	89	2,316,800	48	3,311,600	91	3,466,800	91	2,498,600	69	1,318,500	50
March,	79,881,700	108	6,275,900	75	2,114,500	44	2,718,500	74	2,676,700	70	2,464,800	68	1,358,200	52
April,	75,285,400	101	5,974,500	71	2,063,400	42	2,669,600	73	2,515,600	66	2,459,000	68	1,279,800	49
May,	78,403,300	105	6,052,700	72	2,262,900	46	2,763,100	75	2,580,100	67	2,628,500	72	1,272,800	48
June,	82,435,300	110	6,492,300	77	2,560,900	52	2,950,400	80	2,792,900	73	3,012,500	83	1,455,900	55
July,	80,694,800	108	5,894,500	70	2,241,600	46	2,927,700	79	2,531,100	66	2,776,400	76	1,206,600	46
August,	81,072,200	108	5,731,100	68	2,228,500	45	2,895,500	78	2,497,000	65	2,748,300	75	1,207,500	46
September,	82,675,800	110	6,043,300	71	2,365,100	48	3,020,100	81	2,614,100	68	2,572,600	79	1,302,500	49
October,	80,110,000	107	5,533,200	69	2,154,400	44	2,855,000	77	2,495,600	64	2,606,300	71	1,140,600	43
November,	76,919,000	102	5,640,900	66	2,075,600	42	2,742,300	74	2,426,900	62	2,412,600	66	1,147,000	43
December,	83,804,200	111	6,310,700	74	2,118,000	43	3,063,400	82	2,719,700	70	2,398,800	65	1,155,900	43
For the year,	81,877,800	109	6,199,800	73	2,237,900	46	2,904,400	79	2,688,100	70	2,609,200	72	1,258,900	48

TABLE No. 26. — *Average Daily Consumption of Water in Cities and Towns, etc.* — Continued.

City or town,	MELROSE.			REVERE.			WATERTOWN.			ARLINGTON.			MILTON.			WINTHROP.		
	Population,	15,920.		Per Day.	Per Capita.	21,460.	Per Day.	Per Capita.	14,430.	Per Day.	Per Capita.	12,970.	Per Day.	Per Capita.	8,830.	Per Day.	Per Capita.	
		GALLONS.	Per Capita.															GALLONS.
MONTH.																		
January,	.	.	.	920,400	55	1,531,500	73	875,100	61	705,600	55	332,900	39	585,400	50			
February,	.	.	.	963,300	57	1,725,100	82	888,300	62	765,000	60	351,200	41	615,300	53			
March,	.	.	.	898,300	53	1,390,300	66	950,300	66	699,500	54	352,600	41	604,300	52			
April,	.	.	.	830,500	49	1,419,400	67	931,700	65	720,500	56	311,200	36	610,300	52			
May,	.	.	.	955,600	57	1,539,700	72	993,600	69	867,900	67	380,900	44	678,300	58			
June,	.	.	.	1,106,700	65	1,744,400	82	1,114,200	77	1,258,200	97	408,900	47	910,800	77			
July,	.	.	.	952,500	56	1,761,500	82	970,300	67	935,500	72	304,700	35	858,100	73			
August,	.	.	.	893,500	53	1,741,100	81	982,200	68	890,800	68	312,800	36	859,500	73			
September,	.	.	.	944,500	56	1,647,100	76	1,075,100	74	1,104,400	85	379,200	44	800,400	67			
October,	.	.	.	922,500	54	1,421,200	66	1,030,100	71	918,500	70	384,200	44	716,300	60			
November,	.	.	.	887,900	52	1,309,000	60	994,000	68	725,600	55	339,500	39	711,400	60			
December,	.	.	.	918,000	54	1,395,800	64	1,008,500	69	747,600	57	303,900	35	717,300	60			
For the year,	.	.	.	932,500	55	1,551,000	72	984,800	68	860,500	66	346,700	40	722,800	61			

TABLE No. 26. — Average Daily Consumption of Water in Cities and Towns, etc. — Concluded.

City or town.	STONEHAM.			BELMONT.			LEXINGTON.			NAHANT.			SWAMPSCOTT.			METROPOLITAN DISTRICT.		
	MONTH.																	
	Population.	Per Day.	Per Capita.	Per Day.	Per Capita.	GALLONS.	Per Day.	Per Capita.	GALLONS.	Per Day.	Per Capita.	GALLONS.	Per Day.	Per Capita.	GALLONS.	Per Day.	Per Capita.	GALLONS.
January,	.	352,000	44	414,100	64		324,600	59		72,700	52		338,800	51		112,636,200	100	
February,	.	378,600	48	447,500	69		331,500	60		77,100	54		342,100	51		122,083,600	109	
March,	.	362,100	45	462,900	71		321,700	58		70,600	50		327,000	49		103,980,400	92	
April,	.	359,700	45	477,600	73		331,500	60		90,000	63		341,400	51		98,671,100	87	
May,	.	413,300	51	545,600	84		424,700	77		141,200	99		430,300	64		103,332,500	91	
June,	.	496,000	62	721,000	110		517,900	93		389,500	270		704,700	104		111,072,500	98	
July,	.	406,900	50	463,700	75		406,900	73		316,500	220		575,600	85		106,254,800	94	
August,	.	354,100	44	462,100	70		352,400	63		323,400	223		570,000	84		106,112,000	93	
September,	.	348,100	43	677,400	103		417,700	75		282,300	195		546,700	81		109,116,400	96	
October,	.	349,600	43	512,100	77		368,400	66		138,400	95		427,100	63		104,383,500	91	
November,	.	352,700	43	386,000	58		351,000	63		88,600	61		350,500	51		99,860,500	87	
December,	.	373,100	46	373,600	56		337,300	60		64,700	44		321,800	47		103,131,600	95	
For the year,	.	378,800	47	497,500	76		373,900	67		171,600	119		440,000	65		107,086,100	94	

TABLE NO. 27. — (Pump Basis.) *Consumption of Water in the Metropolitan Water District, as constituted in the Year 1914, and a Small Section of the Town of Saugus, from 1893 to 1914.*
(Gallons per day.)

MONTH.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1901.	1902.	1903.
January,	75,209,000	67,506,000	68,925,000	82,946,000	85,366,000	83,880,000	96,442,000	111,276,000	118,435,000	125,176,000
February,	71,900,000	68,944,000	80,375,000	87,021,000	83,967,000	87,475,000	103,454,000	117,497,000	117,268,000	122,728,000
March,	67,638,000	62,710,000	69,543,000	86,111,000	82,761,000	85,468,000	90,200,000	105,509,000	108,461,000	111,977,000
April,	62,309,000	57,715,000	62,909,000	77,529,000	79,914,000	76,574,000	86,491,000	93,317,000	103,153,000	107,179,000
May,	61,025,000	60,676,000	65,194,000	73,402,000	76,772,000	76,677,000	89,448,000	95,567,000	106,692,000	111,589,000
June,	63,374,000	68,329,000	69,905,000	77,639,000	77,962,000	83,463,000	97,691,000	103,420,000	110,002,000	105,590,000
July,	69,343,000	73,642,000	69,667,000	80,000,000	85,525,000	88,223,000	96,821,000	106,905,000	108,340,000	107,562,000
August,	66,983,000	67,996,000	72,223,000	78,537,000	84,103,000	87,558,000	92,072,000	102,815,000	107,045,000	103,570,000
September,	64,654,000	67,137,000	73,724,000	74,160,000	84,296,000	86,296,000	91,478,000	102,103,000	107,752,000	106,772,000
October,	63,770,000	62,735,000	67,028,000	71,762,000	79,551,000	81,770,000	89,580,000	103,389,000	106,560,000	103,602,000
November,	61,204,000	62,231,000	64,881,000	71,933,000	72,762,000	78,177,000	86,719,000	101,324,000	105,175,000	103,477,000
December,	66,700,000	65,108,000	70,443,000	79,449,000	76,594,000	86,355,000	85,940,000	113,268,000	125,434,000	114,721,000
Average,	66,165,000	63,322,000	69,499,000	78,360,000	80,793,000	83,651,000	92,111,000	104,645,000	110,345,000	110,277,000
Population,	723,153	743,354	763,557	786,385	809,213	832,042	854,870	892,740	907,780	922,820
Per capita,	91.5	88.0	91.0	99.7	99.8	100.5	107.8	117.2	121.6	119.5

See note at end of this table.

TABLE No. 27. — (Pump Basis.) Consumption of Water, etc. — Concluded.
[Gallons per day.]

MONTH.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.
January,	137,771,000	130,878,000	126,093,000	137,730,000	132,370,000	133,276,000	127,568,000	123,281,000	137,277,000	113,489,000	117,387,000
February,	143,222,000	140,595,000	130,766,000	150,822,000	146,199,000	130,763,000	131,093,000	124,359,000	141,440,000	120,713,000	127,083,000
March,	123,334,000	120,879,000	123,570,000	134,202,000	128,534,000	126,842,000	117,078,000	116,669,000	122,804,000	107,871,000	110,106,000
April,	108,688,000	111,898,000	118,428,000	121,556,000	128,926,000	125,335,000	112,775,000	111,656,000	113,308,000	104,086,000	103,609,000
May,	111,715,000	115,804,000	122,404,000	123,502,000	131,040,000	123,305,000	112,073,000	118,095,000	114,548,000	104,311,000	105,821,000
June,	111,209,000	117,441,000	121,882,000	125,623,000	139,843,000	125,179,000	114,082,000	114,145,000	118,793,000	108,193,000	114,165,000
July,	113,584,000	124,769,000	118,726,000	128,779,000	138,232,000	126,765,000	122,743,000	123,082,000	120,261,000	112,084,000	106,233,000
August,	112,836,000	121,158,000	120,591,000	131,098,000	128,073,000	121,781,000	118,373,000	111,091,000	112,968,000	106,660,000	105,786,000
September,	114,189,000	120,103,000	121,685,000	124,751,000	129,972,000	118,043,000	112,434,000	108,726,000	112,352,000	105,449,000	109,873,000
October,	108,280,000	118,301,000	116,561,000	124,081,000	124,189,000	115,839,000	112,332,000	106,873,000	110,220,000	103,756,000	105,241,000
November,	108,054,000	116,693,000	113,746,000	119,627,000	117,119,000	111,664,000	107,528,000	105,373,000	108,289,000	101,441,000	101,228,000
December,	125,119,000	122,696,000	130,965,000	122,407,000	124,468,000	115,733,000	121,994,000	104,592,000	110,114,000	102,480,000	108,741,000
Average,	118,114,000	121,671,000	122,086,000	128,561,000	130,712,000	122,351,000	117,468,000	113,951,000	118,546,000	107,466,000	109,489,000
Population,	937,960	955,920	961,690	1,007,520	1,025,890	1,051,420	1,076,930	1,102,210	1,128,470	1,153,490	1,177,770
Per capita,	125.9	127.3	124.4	127.6	127.4	116.8	109.1	103.4	105.1	93.2	92.1

This table includes the water consumed in the cities and towns enumerated in Table No. 26, together with the water consumed in Newton, which is included in the Metropolitan Water District but has not been supplied from the Metropolitan Works, and a small section of the town of Saugus.

TABLE No. 28. — *Chemical Examinations of Water from the Wachusett Reservoir, Clinton.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			Odor.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.		NITROGEN AS		Oxygen consumed.	Hardness.
		Turbidity.	Sediment.	COLOR. Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.			Nitrates.	Nitrites.		
113755	Jan. 9	None.	V. slight.	10	V. faintly vegetable.	Faintly vegetable.	3.15	1.25	.0023	.0118	.0104	.0014	28	.0000	.0001	.0000	23	0.8
113958	Jan. 20	V. slight.	V. slight.	10	V. faintly vegetable.	Faintly vegetable.	3.30	1.15	.0020	.0138	.0109	.0018	23	.0010	.0000	.0000	25	1.0
114531	Feb. 12	None.	V. slight.	07	V. faintly vegetable.	Faintly vegetable.	3.20	0.95	.0048	.0118	.0109	.0018	23	.0010	.0000	.0000	27	0.8
114593	Feb. 17	None.	V. slight.	10	V. faintly vegetable.	Faintly vegetable.	3.40	1.00	.0048	.0110	.0142	.0022	37	.0010	.0000	.0000	27	1.0
115024	Mar. 3	None.	V. slight.	10	V. faintly vegetable.	Faintly vegetable.	3.40	1.00	.0038	.0104	.0088	.0012	27	.0010	.0000	.0000	25	0.8
115074	Mar. 17	None.	V. slight.	11	V. faintly vegetable.	V. faintly vegetable.	3.45	1.05	.0038	.0138	.0118	.0028	29	.0020	.0000	.0000	25	0.8
115274	Apr. 17	V. slight.	V. slight.	15	V. faintly vegetable.	Faintly vegetable.	3.55	1.00	.0032	.0092	.0078	.0028	33	.0020	.0000	.0000	23	1.4
115769	Apr. 27	V. slight.	V. slight.	11	V. faintly vegetable.	Faintly vegetable.	3.25	0.90	.0034	.0148	.0126	.0022	32	.0020	.0000	.0000	26	1.0
115927	May 5	V. slight.	V. slight.	15	V. faintly vegetable.	V. faintly vegetable.	3.35	0.90	.0012	.0118	.0106	.0006	31	.0020	.0000	.0000	28	1.0
116297	May 19	None.	V. slight.	15	V. faintly vegetable.	Faintly vegetable.	3.80	0.95	.0010	.0102	.0096	.0006	31	.0020	.0000	.0000	23	0.6
116540	May 22	V. slight.	V. slight.	19	V. faintly vegetable.	Faintly vegetable.	4.00	1.45	.0018	.0132	.0114	.0018	29	.0020	.0000	.0000	22	0.8
116848	June 12	V. slight.	V. slight.	20	V. faintly vegetable.	Faintly vegetable.	3.20	1.10	.0022	.0138	.0114	.0024	34	.0020	.0000	.0000	24	0.6
117201	July 7	V. slight.	V. slight.	18	None.	Faintly vegetable.	3.25	0.95	.0022	.0170	.0126	.0044	31	.0010	.0000	.0000	25	1.0
117679	July 21	V. slight.	Slight.	15	Faintly vegetable.	Faintly vegetable and unpalatable.	3.90	1.10	.0022	.0164	.0104	.0060	30	.0000	.0000	.0000	24	0.8
117993	Aug. 4	V. slight.	Slight.	15	Faintly vegetable.	Faintly vegetable.	3.65	1.05	.0010	.0192	.0136	.0056	30	.0000	.0000	.0000	24	0.8
118277	Aug. 18	None.	Slight.	10	V. faintly vegetable.	V. faintly vegetable.	3.15	0.95	.0030	.0138	.0122	.0016	35	.0010	.0000	.0000	20	0.8
118722	Sept. 1	None.	V. slight.	10	V. faintly vegetable.	Faintly vegetable.	3.20	1.00	.0036	.0158	.0132	.0026	30	.0010	.0000	.0000	29	0.8
119061	Sept. 15	None.	V. slight.	10	None.	Faintly vegetable.	3.45	1.05	.0020	.0130	.0110	.0020	27	.0000	.0000	.0000	28	0.8
119461	Oct. 16	V. slight.	V. slight.	10	V. faintly vegetable.	Faintly vegetable.	3.25	0.80	.0018	.0160	.0138	.0022	33	.0020	.0000	.0000	28	0.8
119963	Oct. 20	V. slight.	V. slight.	10	V. faintly vegetable.	V. faintly vegetable.	3.40	0.70	.0008	.0094	.0086	.0008	34	.0000	.0000	.0000	30	1.1
120198	Nov. 3	V. slight.	V. slight.	10	V. faintly vegetable.	V. faintly vegetable.	3.50	1.00	.0018	.0170	.0140	.0030	37	.0000	.0000	.0000	28	0.8
120551	Nov. 17	None.	V. slight.	10	V. faintly vegetable.	Faintly vegetable.	2.90	0.80	.0016	.0134	.0114	.0024	31	.0010	.0000	.0000	23	1.0
120854	Dec. 1	V. slight.	V. slight.	10	V. faintly vegetable.	Faintly vegetable.	2.75	0.80	.0025	.0134	.0116	.0018	32	.0010	.0000	.0000	30	1.3
121248	Dec. 21	V. slight.	V. slight.	09	None.	None.	3.10	0.90	.0022	.0156	.0118	.0038	30	.0020	.0000	.0000	26	1.1
Av.	.....	.....	.....	12	.....	.....	3.30	1.00	.0023	.0138	.0115	.0023	32	.0011	.0000	.0000	25	0.9

TABLE No. 29. — *Chemical Examinations of Water from the Sudbury Reservoir.*
[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen consumed.	Hardness.
		Turbidity.	Sediment.	COLOR. Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	ALBUMINOID.							
										Total.	Dissolved.	Suspended.					
113727	Jan. 5	None.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.85	1.00	.0012	.0140	.0118	.0022	.39	.0050	.0000	.28	1.4
114215	Feb. 2	V. slight.	V. slight.	.13	V. faintly vegetable.	Faintly vegetable.	4.10	1.30	.0032	.0140	.0126	.0014	.34	.0050	.0000	.27	1.3
114765	Mar. 2	V. slight.	V. slight.	.22	Faintly vegetable.	Distinctly vegetable.	4.15	1.15	.0056	.0146	.0116	.0030	.41	.0110	.0001	.33	1.8
115348	Apr. 6	V. slight.	Slight.	.18	Distinctly vegetable.	Distinctly vegetable.	3.95	1.15	.0058	.0124	.0114	.0010	.41	.0110	.0000	.31	1.4
115909	May 4	Slight.	Slight.	.17	V. faintly vegetable.	Faintly vegetable.	3.90	0.70	.0012	.0188	.0174	.0014	.33	.0090	.0000	.26	1.6
116432	June 1	Slight.	Slight.	.21	Distinctly vegetable.	Decidedly vegetable.	4.45	1.45	.0016	.0162	.0114	.0048	.41	.0090	.0001	.26	1.6
117223	July 6	V. slight.	V. slight.	.15	Faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	4.15	1.40	.0018	.0190	.0144	.0046	.34	.0020	.0000	.32	1.6
117940	Aug. 3	V. slight.	V. slight.	.12	Faintly vegetable.	Distinctly vegetable.	3.95	1.35	.0028	.0186	.0156	.0030	.35	.0000	.0000	.29	1.4
118671	Aug. 31	V. slight.	V. slight.	.10	Faintly vegetable.	Distinctly vegetable.	3.60	1.00	.0024	.0166	.0118	.0048	.35	.0000	.0000	.24	1.3
119424	Oct. 5	V. slight.	V. slight.	.10	Faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	3.65	1.35	.0012	.0176	.0138	.0038	.35	.0010	.0001	.23	1.0
120125	Nov. 2	V. slight.	V. slight.	.11	Faintly vegetable and earthy.	Faintly vegetable and earthy.	3.20	0.95	.0022	.0164	-	-	.39	.0010	.0000	.25	1.1
120868	Dec. 1	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.25	1.00	.0030	.0164	.0118	.0046	-	.0020	.0000	.19	1.3
Av.	.....	.....	.....	.14	.....	.....	3.85	1.15	.0027	.0162	.0131	.0031	.37	.0047	.0000	.27	1.4

TABLE NO. 30. — *Chemical Examinations of Water from Spot Pond, Stoneham.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				NITROGEN AS		Oxygen consumed.	Hardness.	
		Turbidity.	Sediment.	Color.					Free.	Total.	Dissolved.	Suspended.					Chlorine.	Nitrates.	Nitrites.
113846	Jan. 12	None.	V. slight.	.02	None.	V. faintly vegetable.	4.00	1.10	.0012	.0136	.0122	.0014	.41	.0000	.0000	.20	1.4
114351	Feb. 9	V. slight.	V. slight.	.05	Faintly unpleasant.	Faintly unpleasant.	3.95	1.05	.0012	.0150	.0124	.0026	.45	.0010	.0000	.21	1.4
114752	Mar. 2	V. slight.	V. slight.	.11	Faintly vegetable.	Faintly vegetable.	3.85	1.00	.0038	.0176	.0140	.0036	.42	.0030	.0000	.23	1.7
115330	Apr. 6	V. slight.	V. slight some Hydra.	.11	V. faintly vegetable.	V. faintly vegetable.	3.45	1.20	.0034	.0198	.0142	.0056	.36	.0050	.0000	.25	1.4
115905	May 4	V. slight.	V. slight.	.10	None.	V. faintly vegetable.	4.00	1.20	.0016	.0158	.0120	.0038	.39	.0030	.0000	.19	1.4
116424	June 1	V. slight.	V. slight.	.05	Faintly vegetable.	Distinctly vegetable and faintly unpleasant.	3.75	0.90	.0014	.0162	.0140	.0022	.41	.0000	.0000	.14	1.6
117220	July 6	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	4.60	1.60	.0020	.0212	-	-	.38	.0000	.0001	.26	1.6
118114	Aug. 10	V. slight.	V. slight.	.06	Faintly vegetable and sweetish.	Distinctly vegetable and sweetish.	3.90	1.25	.0020	.0188	.0154	.0034	.33	.0010	.0000	.23	1.6
118664	Aug. 31	V. slight.	V. slight.	.08	Faintly vegetable.	Distinctly vegetable.	4.20	1.35	.0040	.0196	.0172	.0024	.42	.0000	.0000	.21	1.4
119398	Oct. 5	V. slight.	V. slight.	.08	V. faintly vegetable.	Faintly vegetable.	3.85	1.20	.0016	.0162	-	-	.41	.0000	.0003	.24	1.4
120204	Nov. 3	V. slight.	V. slight.	.05	V. faintly vegetable.	Faintly vegetable.	3.70	1.00	.0012	.0162	.0138	.0024	.40	.0010	.0000	.16	1.4
120879	Dec. 8	None.	V. slight.	.07	V. faintly vegetable.	Faintly vegetable.	3.75	1.10	.0006	.0162	.0130	.0032	.34	.0000	.0000	.22	1.4
Av.	.....	.....	.....	.07	.....	.....	3.92	1.16	.0020	.0172	.0138	.0031	.39	.0012	.0000	.21	1.5

TABLE No. 31. — *Chemical Examinations of Water from Lake Cochituate.*
[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			Odor.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.		NITROGEN AS		Oxygen consumed.	Hardness.
		Turbidity.	Sediment.	COLOR. Platinum Standard.					Free.	ALBUMINOID.								
										Total.	Dissolved.	Suspended.						
113735	Jan. 5	V. slight.	Slight.	.27	Faintly vegetable.	Distinctly vegetable and faintly unpleasant.	6.80	2.20	.0050	.0272	.0176	.0096	.75	.0030	.0000	.47	2.6	
114223	Feb. 2	V. slight.	V. slight.	.27	Faintly vegetable.	Distinctly vegetable and faintly unpleasant.	6.70	2.00	.0056	.0272	.0200	.0072	.71	.0090	.0000	.51	2.3	
114788	Mar. 3	V. slight.	Slight.	.33	Faintly vegetable.	Distinctly vegetable.	6.50	1.40	.0054	.0224	.0160	.0064	.76	.0140	.0000	.46	2.7	
115345	Apr. 6	Slight.	Slight.	.35	Faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	6.60	1.80	.0028	.0242	.0230	.0012	.71	.0100	.0001	.45	2.6	
115906	May 4	Slight.	Considerable.	.27	Faintly vegetable.	Faintly vegetable.	5.80	1.00	.0016	.0336	.0210	.0126	.69	.0090	.0001	.43	2.2	
116474	June 2	Slight.	Slight.	.25	Faintly vegetable and earthy.	Faintly vegetable and earthy.	6.30	2.25	.0016	.0248	.0164	.0084	.68	.0020	.0000	.39	2.2	
117276	July 7	V. slight.	Considerable.	.22	Faintly vegetable.	Distinctly vegetable.	6.40	1.35	.0006	.0318	.0216	.0102	.65	.0000	.0000	.39	2.2	
117955	Aug. 3	V. slight.	V. slight.	.26	Faintly vegetable.	Distinctly vegetable.	6.15	2.05	.0012	.0250	.0204	.0046	.65	.0000	.0003	.35	2.3	
118715	Sept. 1	V. slight.	Slight.	.10	Faintly vegetable.	Distinctly vegetable.	5.80	1.75	.0016	.0174	.0160	.0014	.59	.0010	.0007	.29	2.1	
119428	Oct. 5	V. slight.	Slight.	.11	Faintly vegetable.	Distinctly vegetable.	6.20	1.70	.0012	.0268	.0212	.0046	.62	.0000	.0000	.35	2.2	
120168	Nov. 3	V. slight.	Slight.	.11	V. faintly earthy.	Faintly earthy.	5.10	1.50	.0020	.0246	.0164	.0082	.68	.0020	.0000	.32	2.2	
120870	Dec. 1	V. slight.	V. slight.	.19	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	6.05	1.85	.0236	.0276	.0198	.0078	.60	.0020	.0000	.41	2.7	
Av.	.....	.....	.....	.23	.....	.....	6.20	1.74	.0044	.0260	.0191	.0069	.67	.0043	.0001	.40	2.4

TABLE No. 32. — *Chemical Examinations of Water from a Tap at the State House, Boston.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				NITROGEN AS		Oxygen consumed.	Hardness.
		Turbidity.	Sediment.	COLOR.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Nitrates.	Nitrites.		
113710	Jan. 5	V. slight.	V. slight.	.11	V. faintly vegetable.	Faintly vegetable.	4.10	1.65	.0012	.0130	.0110	.0020	.0050	.0000	.24	1.3
114201	Feb. 2	V. slight.	V. slight.	.18	V. faintly vegetable.	Faintly vegetable.	4.90	1.55	.0014	.0148	.0130	.0018	.0080	.0000	.29	1.3
114734	Mar. 2	V. slight.	None.	.15	V. faintly vegetable.	Faintly vegetable.	4.20	1.15	.0032	.0122	.0094	.0028	.0120	.0000	.25	1.6
115320	Apr. 6	V. slight.	V. slight.	.16	V. faintly vegetable.	Faintly vegetable.	4.10	1.20	.0022	.0138	.0098	.0040	.0190	.0002	.30	1.4
115896	May 4	V. slight.	V. slight.	.17	V. faintly vegetable.	Faintly vegetable.	3.90	0.85	.0008	.0172	.0130	.0042	.0160	.0000	.26	1.3
116409	June 1	Slight.	Slight.	.20	Faintly vegetable.	Distinctly vegetable.	4.85	1.25	.0016	.0124	.0118	.0006	.0140	.0001	.14	1.6
117215	July 6	V. slight.	V. slight.	.19	Faintly vegetable.	Distinctly vegetable.	4.70	1.10	.0008	.0158	.0118	.0040	.0020	.0001	.23	1.6
117925	Aug. 3	V. slight.	V. slight.	.12	Faintly vegetable.	Distinctly vegetable.	4.60	1.35	.0008	.0128	.0118	.0010	.0040	.0000	.25	1.3
118666	Sept. 1	V. slight.	V. slight.	.10	Faintly vegetable.	Distinctly vegetable.	3.65	1.05	.0012	.0138	.0118	.0020	.0040	.0000	.21	1.1
119355	Oct. 5	V. slight.	V. slight.	.12	V. faintly vegetable.	Faintly vegetable.	3.55	1.15	.0010	.0132	.0118	.0014	.0010	.0000	.24	1.4
120113	Nov. 2	V. slight.	V. slight.	.10	V. faintly vegetable.	V. faintly vegetable.	3.45	1.00	.0010	.0132	.0120	.0012	.0030	.0000	.30	1.1
120849	Dec. 2	V. slight.	V. slight.	.10	V. faintly vegetable.	Faintly vegetable.	3.45	1.00	.0018	.0130	.0122	.0008	.0030	.0000	.27	1.4
Av.	.....	.....	.....	.14	.....	.....	4.12	1.19	.0014	.0138	.0116	.0022	.0076	.0000	.25	1.4

TABLE No. 33. — *Averages of Examinations of Water from Various Parts of the Metropolitan Water Works in 1914.*
[Parts per 100,000.]

LOCALITY.	Samples collected.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen consumed.	Hardness.
			Total.	Loss on Ignition.	Free.	ALBUMINOID.		Suspended.		Nitrates.	Nitrites.		
						Total.	Dissolved.						
		Platinum Standard.											
		.37	4.17	1.32	.0020	.0174	.0142	.0032	.47	.0043	.0000	.45	0.8
	Semi-monthly,	.31	3.67	1.24	.0022	.0152	.0121	.0031	.25	.0030	.0000	.46	0.9
	Semi-monthly,	.23	3.48	1.20	.0020	.0146	.0120	.0026	.31	.0034	.0000	.34	0.9
	Semi-monthly,	.12	3.30	1.00	.0023	.0138	.0115	.0023	.32	.0011	.0000	.25	0.9
	Semi-monthly,	.13	3.52	1.04	.0026	.0126	.0102	.0024	.43	.0032	.0000	.25	0.9
	Monthly,	.55	19.42	5.02	.1433	.0383	.0309	.0074	3.27	.1473	.0069	.67	7.1
	Monthly,	.04	16.39	-	.0013	.0096	-	-	2.18	.2971	.0002	-	5.6
	Monthly,	.18	3.43	1.10	.0030	.0149	.0122	.0027	.31	.0061	.0001	.33	1.1
	Monthly,	.14	3.85	1.15	.0027	.0162	.0131	.0030	.37	.0047	.0000	.27	1.4
	Monthly,	.13	3.91	1.15	.0038	.0147	.0121	.0026	.37	.0063	.0001	.26	1.4
	Monthly,	.14	3.90	1.19	.0027	.0145	.0121	.0024	.36	.0048	.0000	.27	1.5
	Monthly,	.15	3.76	1.08	.0038	.0165	.0143	.0022	.37	.0044	.0001	.27	1.4
	Monthly,	1.29	6.51	3.11	.0061	.0385	.0332	.0053	.47	.0034	.0001	1.33	2.5
	Monthly,	.50	4.41	1.69	.0026	.0208	.0181	.0027	.40	.0031	.0001	.64	1.2
	Monthly,	.50	4.53	1.66	.0035	.0197	.0173	.0024	.40	.0043	.0001	.63	1.2
	Monthly,	.84	5.16	2.16	.0033	.0282	.0239	.0043	.42	.0042	.0000	.87	1.4
	Monthly,	.60	4.41	1.79	.0031	.0232	.0200	.0032	.39	.0019	.0001	.70	1.2
	Monthly,	.61	4.53	1.77	.0037	.0224	.0198	.0026	.39	.0026	.0000	.69	1.3
	Monthly,	.75	5.51	2.20	.0046	.0289	.0252	.0041	.47	.0054	.0000	.85	1.5
	Monthly,	.72	5.09	1.98	.0051	.0285	.0243	.0042	.44	.0040	.0001	.79	1.4
	Monthly,	.23	6.20	2.06	.0044	.0260	.0191	.0069	.67	.0043	.0001	.40	2.4
	Monthly,	.50	6.90	2.06	.0369	.0328	.0197	.0131	.67	.0046	.0000	.46	2.7
	Monthly,	.13	3.79	1.10	.0028	.0146	.0124	.0022	.37	.0063	.0000	.25	1.4
	Monthly,	.15	3.82	1.16	.0022	.0142	.0121	.0021	.37	.0047	.0000	.26	1.4
	Monthly,	.07	3.92	1.16	.0020	.0172	.0138	.0031	.39	.0012	.0000	.21	1.5
	Monthly,	.07	3.78	1.11	.0013	.0145	.0124	.0021	.40	.0008	.0000	.20	1.5
	Monthly,	.14	4.12	1.19	.0014	.0138	.0116	.0022	.39	.0076	.0000	.25	1.4
	Monthly,	.12	3.78	1.07	.0013	.0124	.0106	.0018	.37	.0083	.0001	.22	1.4

² Average of 11 samples.

¹ Average of 7 samples.

TABLE No. 34. — *Chemical Examinations of Water from a Faucet in Boston, from 1892 to 1914.*

[Parts per 100,000.]

YEAR.	COLOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen consumed.	Hardness.
	Nessler Standard.	Platinum Standard.	Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
						Total.	Dissolved.	Suspended.					
1892, . . .	.37	.37	4.70	1.67	.0007	.0168	.0138	.0030	.41	.0210	.0001	-	1.9
1893, . . .	.61	.53	4.54	1.84	.0010	.0174	.0147	.0027	.38	.0143	.0001	.60	1.8
1894, . . .	.69	.58	4.64	1.83	.0006	.0169	.0150	.0019	.41	.0106	.0001	.63	1.7
1895, . . .	.72	.59	4.90	2.02	.0006	.0197	.0175	.0022	.40	.0171	.0001	.69	0.7
1896, . . .	.49	.45	4.29	1.67	.0005	.0165	.0142	.0023	.37	.0155	.0001	.56	1.4
1897, . . .	.65	.55	4.82	1.84	.0009	.0193	.0177	.0016	.40	.0137	.0001	.64	1.6
1898, . . .	.41	.40	4.19	1.60	.0008	.0152	.0136	.0016	.29	.0097	.0001	.44	1.4
1899, . . .	.23	.28	3.70	1.30	.0006	.0136	.0122	.0014	.24	.0137	.0001	.35	1.1
1900, . . .	.24	.29	3.80	1.20	.0012	.0157	.0139	.0018	.25	.0076	.0001	.38	1.3
1901, . . .	.24	.29	4.43	1.64	.0013	.0158	.0142	.0016	.30	.0173	.0001	.42	1.7
1902, . . .	.26	.30	3.93	1.56	.0016	.0139	.0119	.0020	.29	.0092	.0000	.40	1.3
1903, . . .	.25	.29	3.98	1.50	.0013	.0125	.0110	.0015	.30	.0142	.0001	.39	1.5
1904, . . .	-	.23	3.93	1.59	.0023	.0139	.0121	.0018	.34	.0110	.0001	.37	1.5
1905, . . .	-	.24	3.86	1.59	.0020	.0145	.0124	.0021	.35	.0083	.0001	.35	1.4
1906, . . .	-	.24	3.86	1.39	.0018	.0159	.0134	.0025	.34	.0054	.0001	.36	1.3
1907, . . .	-	.22	3.83	1.40	.0013	.0129	.0109	.0020	.33	.0068	.0001	.32	1.3
1908, . . .	-	.19	3.50	1.35	.0011	.0115	.0092	.0024	.33	.0092	.0001	.26	1.2
1909, . . .	-	.18	3.46	1.43	.0011	.0128	.0103	.0025	.28	.0034	.0000	.25	1.3
1910, . . .	-	.14	3.05	1.24	.0013	.0118	.0102	.0016	.28	.0030	.0000	.22	1.1
1911, . . .	-	.25	4.18	1.66	.0015	.0156	.0128	.0029	.38	.0029	.0000	.33	1.4
1912, . . .	-	.17	3.86	1.23	.0018	.0154	.0119	.0034	.36	.0062	.0000	.29	1.7
1913, . . .	-	.13	3.96	1.15	.0014	.0150	.0120	.0026	.35	.0064	.0000	.26	1.5
1914, . . .	-	.14	4.12	1.19	.0014	.0138	.0116	.0022	.39	.0076	.0000	.25	1.4

TABLE No. 35. — *Microscopic Organisms in Water from Various Parts of the Metropolitan Water Works, from 1898 to 1914, inclusive.*
 [Standard units per cubic centimeter; averages from weekly or biweekly observations.]

YEAR.	WACHUSETT RESERVOIR.		SUDBURY RESERVOIR.		LAKE COCHITUATE.		FRAMINGHAM RESERVOIR.		FRAMINGHAM RESERVOIR.		ASHLAND RESERVOIR.		HOPKINTON RESERVOIR.		WHITEHALL RESERVOIR.	
	Surface. Bottom.		Surface. Bottom.		Surface. Bottom.		No. 3. Surface.		No. 2. Mid-depth.		Surface.		Surface.		Surface.	
1898.	354	149	830	696	390	245	944	263	944	690
1899.	470	252	905	644	440	218	715	357	715	393
1900.	498	361	1,758	1,071	645	365	980	390	980	437
1901.	337	225	992	702	336	149	450	244	450	705
1902.	590	402	1,071	730	627	204	588	550	588	198
1903.	549	388	931	795	459	169	231	323	231	327
1904.	517	376	663	542	475	174	106	153	106	375
1905.	644	502	1,255	503	535	158	289	289	240	147
1906.	953	714	1,407	1,143	692	226	475	431	475	1,279
1907.	513	419	1,123	1,200	413	205	336	378	336	961
1908.	850	885	1,559	1,241	932	725	516	699	516	708
1909.	2,474	2,513	1,142	1,198	2,372	610	294	603	294	445
1910.	464	556	928	1,033	455	436	387	426	387	154
1911.	900	988	1,942	2,216	1,140	378	457	592	457	397
1912.	368	939	4,982	7,873	888	241	516	665	516	390
1913.	449	553	4,964	7,322	560	253	298	414	298	494
1914.	753	692	2,036	4,189	532	-	325	327	325	89

See note at end of this table.

TABLE No. 35. — *Microscopic Organisms in Water, etc.* — Concluded.
[Standard units per cubic centimeter; averages from weekly or biweekly observations.]

YEAR.	WESTON RESERVOIR.		SPOT POND.		CHESTNUT HILL RESERVOIR.				TAPS.				
	Surface.		Surface.		SUDBURY AQUEDUCT.		COCHITUATE AQUEDUCT.		EFFLUENT GATE-HOUSE.	Southern Low Service.	Southern High Service.	Northern Low Service.	Northern High Service.
					Inlet.		Inlet.						
1898,	-	485	304	544	304				230	-		-	-
1899,	-	1,129	359	992		329			192	201		-	-
1900,	-	573	568	1,139		897			468	452		-	-
1901,	-	628	344	697		413			243	280		-	-
1902,	-	581	563	937		525			367	451		-	-
1903,	-	650	450	860		435			286	398		-	-
1904,	-	465	405	838		472			303	470	274	189	
1905,	-	609	551	904		554			528	671	363	388	
1906,	783	671	631	1,042		721			550	583	326	422	
1907,	443	590	349	909		419			312	427	205	422	
1908,	979	741	783	1,073		689			666	695	443	431	
1909,	2,399	1,079	1,999	632		1,899			1,913	1,959	1,313	677	
1910,	625	622	457	-		465			447	421	221	374	
1911,	934	748	700	1,382		954			778	735	349	461	
1912,	1,117	716	855	3,887		919			1,035	967	412	462	
1913,	565	607	535	2,622		850			531	410	237	356	
1914,	757	648	492	-		540			603	549	249	412	

NOTE. — A large growth of *Asterionella* originated in the Wachusett Reservoir in 1909, causing the large number of organisms in the water of Sudbury Reservoir and Framingham Reservoir No. 3, Weston and Chestnut Hill reservoirs, Spot Pond and in the water drawn from taps.

TABLE NO. 36. — *Number of Bacteria per Cubic Centimeter in Water from Various Parts of the Metropolitan Water Works, from 1898 to 1914, inclusive.*

[Averages of weekly determinations.]

YEAR.	CHESTNUT HILL RESERVOIR.			SOUTHERN SERVICE TAPS.	
	Sudbury Aqueduct Terminal Chamber.	Cochituate Aqueduct.	Effluent Gate-house No. 2.	Low Service, 180 Boylston Street.	High Service, 1 Ashburton Place.
1898,	207	145	111	96	—
1899,	224	104	217	117	123
1900,	248	113	256	188	181
1901,	225	149	169	162	168
1902,	203	168	121	164	246
1903,	76	120	96	126	243
1904,	347	172	220	176	355
1905,	495	396	489	231	442
1906,	231	145	246	154	261
1907,	147	246	118	130	176
1908,	162	138	137	136	148
1909,	198	229	119	150	195
1910,	216	—	180	178	213
1911,	205	204	151	175	197
1912,	429	450	227	249	259
1913,	123	243	157	119	140
1914,	288	—	252	174	220
Averages,	237	201	192	160	223

TABLE No. 37. — Colors of Water from Various Parts of the Metropolitan Water Works in 1914. (Averages of Weekly Determinations.)
[Platinum Standard.]

MONTH.	WACUSSETT RESERVOIR.				SUDBURY RESERVOIR.				FRAMINGHAM RESERVOIR.		LAKE COCHITUATE.				CHESTNUT HILL RESERVOIR.			SPOT FOND.	FELLS RESERVOIR.	NORTHERN SERVICE.		SOUTHERN SERVICE.			
	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Mid-depth.	No. 2.	No. 3.	Surface.	Mid-depth.	Bottom.	Influent Streams. ¹	Inlet (Sudbury Aqueduct).			Inlet (Cochituate Aqueduct).	Effluent Gate-house No. 2.	Mid-depth.	Effluent Gate-house.	Tap at Fire Station, Hancock Street, Everett (High Service).	Tap at 180 Boylston Street, Boston (Low Service).	Tap at 1 Ashburton Place, Boston (High Service).
January,	9	9	8	24	29	14	14	12	-	14	26	36	16	16	14	8	7	14	14	14	15	14	14	14	15
February,	9	9	9	32	33	30	16	16	14	14	27	29	39	38	16	15	9	9	14	15	15	14	14	14	15
March,	10	11	11	32	32	29	16	16	17	17	29	27	40	38	16	20	9	9	15	15	19	20	20	20	20
April,	14	14	15	37	39	37	21	22	44	22	30	32	33	46	22	20	10	10	19	20	20	20	20	20	20
May,	17	18	17	42	49	45	30	22	22	22	28	28	31	55	21	11	10	10	19	20	20	20	20	20	20
June,	18	17	18	28	36	30	21	22	22	21	26	28	35	62	21	11	11	11	19	20	20	20	20	20	20
July,	16	17	18	20	38	36	17	18	17	15	20	26	33	40	15	11	11	11	19	20	20	20	20	20	20
August,	14	15	16	13	29	29	14	16	16	18	24	26	53	40	15	11	11	11	19	20	20	20	20	20	20
September,	14	15	16	15	21	19	14	15	16	15	16	25	75	34	15	14	10	10	14	14	14	14	14	14	15
October,	12	13	15	13	29	24	14	14	14	14	16	22	268	33	14	13	10	10	14	14	14	14	14	14	14
November,	12	13	14	15	29	27	13	13	14	14	17	20	68	33	14	14	9	9	14	14	14	14	14	14	14
December,	13	13	13	21	32	27	13	13	14	13	20	22	24	31	14	14	12	14	14	14	14	14	14	14	14
Averages,	13	14	14	24	34	30	16	17	17	19	23	25	60	41	17	16	10	9	16	16	9	16	9	16	16

¹ The colors given in this column represent the combined colors of the waters of the four principal feeders. The color of each is determined monthly, and due weight is given in combining the results to the sizes of the streams.

TABLE No. 38. — *Temperatures of Water from Various Parts of the Metropolitan Water Works in 1914. (Averages of Weekly Determinations.)*

[The temperatures are taken at the same places and times as the samples for microscopical examination; the depth given for each reservoir is the depth from high-water mark.]

(Degrees Fahrenheit.)

MONTH.	WACHUSETT RESERVOIR (DEPTH AT PLACE OF OBSERVATION 107 FEET).			SUDBURY RESERVOIR (DEPTH AT PLACE OF OBSERVATION 54.5 FEET).			WACHUSETT AQUEDUCT.			FRAMINGHAM RESERVOIR No. 2 (DEPTH AT PLACE OF OBSERVATION 20.5 FEET).			LAKE COCHITUATE (DEPTH AT PLACE OF OBSERVATION 62.0 FEET).			CHESTNUT HILL RESERVOIR.			SPOT POND (DEPTH AT PLACE OF OBSERVATION 28.0 FEET).			NORTHERN SERVICE.		SOUTHERN SERVICE.	
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	Effluent Gate-house No. 2.	Surface.	Mid-depth.	Bottom.	Tap at Glenwood Yard, Medford (Low Service).	Tap at Fire Station, Hancock Street, Fyvere (High Service).	Tap at 180 Boylston Street, Boston (Low Service).	Tap at 1 Ashburton Place, Boston (High Service).	
January, . . .	33.2	35.0	-	34.1	36.1	37.0	33.8	36.3	36.3	36.3	35.5	37.0	37.8	36.3	35.9	36.9	39.0	39.0	39.0	39.8	39.0	39.8	40.1		
February, . . .	33.3	35.5	34.5	34.4	36.3	37.2	34.2	36.2	36.5	36.4	35.0	36.8	37.3	36.9	37.4	38.3	39.0	39.0	39.0	38.6	39.0	38.4	39.1		
March, . . .	34.8	34.9	36.0	34.9	36.3	37.2	34.3	36.2	36.9	36.9	36.7	36.0	40.7	36.9	39.0	39.5	38.6	39.6	39.6	38.6	39.6	39.4	40.0		
April, . . .	33.4	39.8	40.0	42.8	42.0	43.8	40.5	45.3	43.6	46.1	44.3	43.0	43.5	45.5	44.4	44.0	45.5	46.3	45.8	45.5	46.3	45.4	47.4		
May, . . .	51.6	47.3	45.3	58.1	54.2	54.0	49.3	58.3	55.9	58.1	57.4	50.5	47.5	56.6	55.4	54.5	53.8	54.3	54.3	53.8	54.2	57.5	57.5		
June, . . .	64.2	61.2	48.7	68.3	64.3	62.8	56.7	69.6	66.8	66.0	67.2	52.3	49.0	67.4	67.0	65.8	67.4	66.2	66.2	67.4	67.4	63.9	67.3		
July, . . .	69.9	65.5	58.6	72.3	67.8	66.3	57.5	72.4	73.8	70.4	70.3	52.0	50.0	72.3	72.5	71.3	72.0	71.0	71.0	70.5	71.4	68.7	71.3		
August, . . .	71.9	68.8	51.0	73.3	69.3	67.6	61.0	73.6	74.4	72.9	72.0	53.0	50.5	73.3	73.3	73.3	73.3	72.5	71.9	71.9	72.5	71.4	73.5		
September, . . .	68.0	64.5	51.3	68.1	69.5	64.8	61.0	67.0	65.5	65.6	66.8	52.5	50.0	67.6	67.5	67.0	68.6	68.0	68.0	68.0	67.0	67.0	68.8		
October, . . .	60.5	60.5	50.5	59.8	60.3	58.5	57.5	58.2	59.9	56.5	59.3	52.3	50.0	60.1	60.4	60.3	61.5	62.3	62.3	64.5	62.3	61.0	62.4		
November, . . .	48.7	50.3	46.8	46.5	49.3	45.0	47.0	43.7	50.0	46.0	46.5	45.0	40.0	47.3	47.5	45.8	50.3	50.3	50.3	54.0	52.4	51.4	50.3		
December, . . .	37.3	37.3	40.0	35.7	36.8	37.0	39.0	35.5	35.7	35.3	37.4	39.0	38.3	37.3	36.9	37.3	37.7	37.7	37.7	44.6	41.4	40.0	41.1		
Averages, . . .	51.1	49.9	45.7	52.4	51.9	50.9	47.7	52.5	53.4	51.8	52.4	45.8	45.1	53.0	53.1	52.7	53.2	54.7	54.4	53.4	54.9				

TABLE NO. 39. — *Temperatures of the Air at Three Stations on the Metropolitan Water Works in 1914.*

[Degrees Fahrenheit.]

MONTH.	CHESTNUT HILL RESERVOIR.			FRAMINGHAM.			CLINTON.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
January,	60	—9	27.3	60	—12	26.4	55	—12	23.4
February,	52	—12	23.0	51	—14	20.7	53	—16	18.3
March,	72	12	35.7	72	10	35.1	64	10	32.9
April,	87	22	45.4	85	20	44.9	—	22	—
May,	95	36	60.0	94	33	60.1	86	32	60.8
June,	93	41	66.5	93	44	66.2	89	45	64.5
July,	89	46	68.5	89	46	68.3	85	49	67.1
August,	92	46	69.5	92	48	69.7	89	48	68.3
September,	95	32	63.5	94	29	62.4	92	28	61.2
October,	80	22	56.4	81	21	55.0	80	25	53.9
November,	73	15	41.7	71	14	39.9	69	12	38.8
December,	60	—4	29.0	61	—12	26.8	63	—11	25.1
Averages,	—	—	48.9	—	—	48.0	—	—	—

TABLE No. 40. — Table showing Length of Main Lines of Water Pipes and Connections owned and operated by Metropolitan Water and Sewerage Board, and Number of Valves set in Same, Dec. 31, 1914.

	DIAMETER OF PIPES IN INCHES.														Total.	
	60	48	42	40	36	30	24	20	16	14	12	10	8	6		4
Total length owned and operated Dec. 31, 1913 (feet).	29,334 ¹	211,186	9,183	6,989	61,413	49,221 ²	74,157	70,786	67,779	26	26,313	3,768	1,860	962	8	612,985
Gate valves in same,	3	53	1	2	55	41	52	50	77	1	100	18	17	22	—	492
Air valves in same,	25	124	3	3	47	18	37	42	33	—	10	1	—	—	—	343
Length laid or relaid during 1914 (feet),	—	225	627	—	572	466	10,088	5,283	51	—	186	18	18	—	—	17,534
Gate valves in same,	—	1	—	—	—	—	5	4	2	—	5	—	1	—	—	18
Air valves in same,	—	—	—	—	—	2	3	3	—	—	—	—	—	—	—	8
Length abandoned during 1914 (feet),	—	312	—	—	822	—	805	—	—	—	—	—	—	—	—	1,939
Gate valves in same,	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	4
Air valves in same,	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	4
Length owned and operated Dec. 31, 1914 (feet).	29,334 ¹	211,099	9,810	6,989	61,163	49,687 ²	83,440	76,069	67,830	26	26,499	3,786	1,878	962	8	628,580 ²
Gate valves in same,	3	54	1	2	51	41	57	54	79	1	105	18	18	22	—	506
Air valves in same,	25	124	3	3	43	20	40	45	33	—	10	1	—	—	—	347

¹ Includes 2,035 feet of 76-inch concrete-lined pressure tunnel and 983 feet of 76-inch mortar-lined and concrete-covered steel pipe, and 21 feet of 76-inch cast-iron pipe.
² Includes 15,565 feet of 30-inch mortar-lined and covered wrought-iron pipe.
³ 119.05 miles.

TABLE NO. 41. — *Statement of Cast-iron Hydrant, Blow-off and Drain Pipes, owned and operated by Metropolitan Water and Sewerage Board, Dec. 31, 1914.*

	DIAMETER OF PIPES IN INCHES.								Total.
	24	20	16	12	10	8	6	4	
Total length in use Dec. 31, 1913 (feet),	352	293	2,516	5,826	173	356	3,199	1,425	14,440
Valves in same,	-	-	29	102	1	3	77	43	255
Length laid or relaid in 1914 (feet),	-	-	389	657	3	33	263	47	1,392
Valves in same,	-	-	3	2	1	1	2	-	9
Length abandoned in 1914 (feet),	-	1	112	28	-	39	10	-	190
Valves in same,	-	-	2	-	-	-	-	-	2
Total length in use Dec. 31, 1914 (feet),	352	292	3,093	6,455	176	350	3,452	1,472	15,642 ¹
Valves in same,	-	-	30	104	2	4	79	43	262

¹ 2.96 miles.

TABLE No. 42. — Length of Water Pipes, Four Inches in Diameter and Larger, in the Several Cities and Towns supplied by the Metropolitan Water Works, Dec. 31, 1914.

BY WHOM OWNED.	INCHES.																		TOTALS.		
	60	48	42	40	36	30	28	24	20	18	16	14	13	12	10	8	7	6	4	Feet.	Miles.
Metropolitan Water Works.	29,334	211,099	9,810	6,989	61,163	49,637	-	83,440	76,069	-	67,830	26	-	26,499	3,786	1,878	-	962	8	628,580	119.05
Boston, . . .	-	10,637	15,476	16,105	37,763	83,656	244	75,046	87,643	-	237,840	5,021	-	1,374,924	303,385	758,315	-	1,291,541	113,984	4,411,580	835.53
Somerville, . .	-	-	-	-	-	-	-	-	3,721	367	4,021	7,950	-	86,020	55,458	105,604	-	211,461	20,958	495,560	93.86
Malden, . . .	-	-	-	-	-	-	-	-	-	-	2,735	9,155	-	75,635	31,272	78,778	-	216,452	59,020	473,047	89.59
Chelsea, . . .	-	-	-	-	-	-	-	-	-	-	5,176	-	-	5,479	39,826	28,808	-	140,536	7,005	226,830	42.96
Everett, . . .	-	-	-	-	-	-	-	2,484	2,900	-	5,204	3,551	-	5,631	42,320	24,378	-	142,223	30,900	259,291	49.11
Quincy, . . .	-	-	-	-	-	-	-	-	2,679	-	23,232	-	-	29,125	41,088	126,437	994	334,729	100,868	669,152	124.84
Medford, . . .	-	-	-	-	-	-	-	-	678	-	6,775	9,598	-	28,452	38,900	87,539	-	139,355	28,813	340,105	64.41
Melrose, . . .	-	-	-	-	-	-	-	-	5,223	2,920	-	5,223	2,920	22,156	19,846	25,147	-	142,825	56,722	274,839	52.05
Revere, ¹ . . .	-	-	-	-	-	-	-	-	23,800	5,785	23,800	5,785	1,200	20,909	23,705	30,443	-	91,639	74,905	272,286	51.57
Watertown, . .	-	-	-	-	-	-	-	-	400	11,877	-	-	-	6,959	10,172	22,092	-	136,831	12,666	199,997	37.88
Arlington, . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	24,136	28,212	38,569	-	121,892	12,081	224,890	42.59
Milton, . . .	-	-	-	-	-	-	-	-	103	44	-	-	-	22,556	20,926	51,820	-	144,188	17,249	256,886	48.65
Winthrop, . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	4,049	23,941	33,685	-	49,327	56,491	167,493	31.72
Stoneham, . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	7,425	1,825	4,543	-	106,179	17,256	137,228	25.99
Belmont, . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	5,714	16,954	24,145	-	102,993	269	150,075	28.42
Lexington, . .	-	-	-	-	-	-	-	-	-	-	-	-	-	9,000	4,879	30,643	-	100,120	27,280	171,922	32.56
Nahant, . . .	-	-	-	-	-	-	-	-	-	-	4,000	-	-	150	11,550	4,800	-	36,800	58,908	116,208	22.01
Swampscott, . .	-	-	-	-	-	-	-	-	-	-	3,045	-	-	4,890	18,306	6,593	-	69,854	9,025	111,713	21.16
Total feet, . .	29,334	221,736	25,286	23,094	98,926	133,343	244	160,970	173,635	367	382,339	62,972	1,200	1,758,709	736,351	1,484,217	994	3,579,807	704,108	9,577,682	-
Total miles, . .	5.55	41.99	4.79	4.37	18.74	25.27	0.05	30.49	32.89	0.07	72.41	11.92	0.23	333.09	139.46	281.10	0.19	677.99	133.35	-	1,813.95

¹ Includes small portion of Saugus.

TABLE NO. 43. — *Number of Service Pipes, Meters and Fire Hydrants in the Several Cities and Towns supplied by the Metropolitan Water Works, Dec. 31, 1914, and the Number of Services and Meters installed during the Year 1914.*

CITY OR TOWN.	Services.	Meters.	Fire Hydrants.	Services Installed.	Meters Installed.
Boston,	101,952	48,360	9,121	1,492	7,132
Somerville,	13,032	8,499	1,190	230	653
Malden,	7,684	7,609	561	126	101
Chelsea,	4,864	4,795	373	98	104
Everett,	5,768	2,604	570	85	346
Quincy,	8,930	8,070	1,041	393	690
Medford,	5,442	5,443	635	357	372
Melrose,	3,914	4,131	354	135	96
Revere, ¹	4,244	2,704	276	235	709
Watertown,	2,573	2,581	364	156	156
Arlington,	2,526	2,530	448	127	130
Milton,	1,760	1,760	404	86	86
Winthrop,	2,821	2,747	263	81	80
Stoneham,	1,581	1,480	154	48	149
Belmont,	1,330	1,330	230	102	102
Lexington,	1,113	947	187	50	106
Nahant,	655	378	100	25	41
Swampscott,	1,748	1,748	172	58	58
Totals,	171,937	107,716	16,443	3,884	11,111

¹ Includes small portion of Saugus.

TABLE NO. 44. — Average Maximum and Minimum Monthly Heights, in Feet, above Boston City Base, to which Water rose at Different Stations on the Metropolitan Water Works in 1914.

1914. MONTH.	LOW SERVICE.										SOUTHERN HIGH SERVICE.								
	BOSTON ENGINE HOUSE, BULFINCH STREET.		ALLSTON ENGINE HOUSE, HARVARD STREET.		MEDFORD, MYSTIC RESERVOIR.		MEDFORD CITY HALL ANNEX, HIGH STREET.		SOMERVILLE ¹ CITY HALL ANNEX, WALNUT STREET.		MALDEN WATER WORKS SHOP, GREEN STREET.		CHELSEA COURT HOUSE.		BOSTON METRO- POLITAN WATER WORKS OFFICE, 1 ASHBURTON PLACE.		WATERTOWN WATER WORKS OFFICE, MAIN STREET.		
	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.
January, .	157	134	175	169	165	162	167	163	167	163	165	162	164	156	246	231	263	255	
February, .	155	134	175	170	165	163	166	163	166	163	165	162	164	155	246	231	262	253	
March, .	162	141	174	167	166	163	167	162	166	162	165	163	165	158	247	232	261	250	
April, .	164	139	176	166	167	163	167	163	168	161	166	162	165	155	246	232	263	253	
May, .	165	143	176	166	167	162	167	162	166	161	166	162	166	155	247	231	261	246	
June, .	164	140	176	168	167	162	167	160	-	-	167	163	165	155	247	232	261	241	
July, .	164	141	175	168	167	163	167	161	167	163	166	162	166	156	248	233	260	248	
August, .	164	144	174	167	166	162	166	161	167	163	166	162	166	156	247	232	261	248	
September, .	164	142	176	168	166	162	166	162	168	164	166	163	164	154	248	230	261	244	
October, .	163	144	176	168	166	163	166	161	168	163	166	162	166	157	248	231	263	246	
November, .	163	145	176	167	166	162	166	161	167	163	167	163	166	156	249	234	263	250	
December, .	162	144	177	166	166	162	165	161	167	162	167	163	166	154	248	233	262	250	
Averages, .	162	141	176	168	166	162	166	162	167	163	166	162	165	155	247	232	262	249	

¹ Somerville Public Library after July 1.

TABLE NO. 44. — *Average Maximum and Minimum Monthly Heights, in Feet, above Boston City Base, etc. — Concluded.*

1914. MONTH.	SOUTHERN HIGH SERVICE — Concluded.								NORTHERN HIGH SERVICE.								NORTHERN EXTRA HIGH SERVICE.			
	BELMONT WATER WORKS SHOP, WAYER- LEY STREET.		MILTON WATER WORKS OFFICE, ADAMS STREET.		FORBES HILL TOWER, QUINCY.		QUINCY WATER WORKS SHOP.		SOMERVILLE PUMPING STA- TION, CEDAR STREET.		MALDEN CITY HALL.		REVERE WATER WORKS OFFICE, BROADWAY.		LYNN ENGINE HOUSE, UNION SQUARE.		WINTHROP TOWN HALL, HERMAN STREET.		LEXINGTON TOWN HALL, MASSACHUSETTS AVENUE.	
	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Maximum.	Minimum.	Maximum.	Maximum.	Minimum.	Maximum.	Maximum.	Minimum.	Maximum.
January,	263	247	248	233	242	229	241	220	270	251	270	265	267	259	267	258	188	174	431	418
February,	261	247	248	234	240	228	241	220	270	250	270	265	265	257	260	250	187	172	429	418
March,	259	243	249	236	243	229	242	220	269	250	269	266	268	258	266	256	187	173	430	418
April,	259	243	250	236	244	230	242	221	269	250	269	266	267	257	263	253	186	173	432	407
May,	256	235	250	236	243	228	242	218	268	246	269	263	263	250	261	248	184	171	432	396
June,	260	218	251	232	244	221	242	211	268	231	267	257	259	233	253	208	185	161	417	395
July,	258	231	251	238	245	230	243	219	268	248	267	261	259	240	258	230	184	169	425	412
August,	254	235	251	239	243	231	242	222	268	249	266	262	259	244	258	233	184	178	423	411
September,	256	219	250	237	243	228	242	218	268	245	268	262	260	247	257	238	183	169	424	410
October,	261	242	250	238	242	231	240	221	268	246	269	263	263	253	260	249	187	172	426	412
November,	260	246	250	239	244	233	242	224	270	249	270	264	266	255	262	251	193	169	430	417
December,	260	250	250	239	244	234	243	226	270	250	269	265	266	257	263	254	196	179	429	415
Averages,	259	238	250	236	243	229	242	220	269	247	269	263	264	251	261	244	187	172	427	411

APPENDIX NO. 3.

WATER WORKS STATISTICS FOR THE YEAR 1914.

The Metropolitan Water Works supply the Metropolitan Water District which includes the following cities and towns: —

CITY OR TOWN.	Population, Census of 1910.	Estimated Population, July 1, 1914.
Boston,	670,585	747,830
Somerville,	77,236	84,530
Malden,	44,404	48,950
Chelsea,	32,452	36,910
Newton, ¹	39,806	43,580
Everett,	33,484	38,500
Quincy,	32,642	36,410
Medford,	23,150	26,430
Hyde Park,	15,507	— ²
Melrose,	15,715	16,920
Revere,	18,219	21,460
Watertown,	12,875	14,430
Arlington,	11,187	12,970
Milton,	7,924	8,630
Winthrop,	10,132	11,820
Stoneham,	7,090	8,070
Swampscott,	6,204	6,770
Lexington,	4,918	5,550
Belmont,	5,542	6,560
Nahant,	1,184	1,440
Total population of Metropolitan Water District,	1,070,256	1,177,770
Saugus, ³	280	280

¹ No water supplied during the year from Metropolitan Water Works.

² Included in Boston.

³ Only a small portion of Saugus was supplied with water.

*Pumping.**Chestnut Hill Pumping Station No. 1:—*

Builders of pumping machinery, Holly Manufacturing Company, Quintard Iron Works and E. P. Allis Company.

Description of coal used:— Bituminous: Beaver Run and Sterling. Anthracite: buckwheat. Price per gross ton in bins: bituminous \$4.10, buckwheat \$3.16. Average price per gross ton \$4.02. Per cent. ashes 12.7.

Chestnut Hill Pumping Station No. 2:—

Builders of pumping machinery, Holly Manufacturing Company.

Description of coal used:— Bituminous: Beaver Run and Sterling. Anthracite: buckwheat. Price per gross ton in bins: bituminous \$4, buckwheat, \$2.84 to \$2.90. Average price per gross ton \$3.86. Per cent. ashes 12.3.

Spot Pond Station:—

Builders of pumping machinery, Geo. F. Blake Manufacturing Company and Holly Manufacturing Company.

Description of coal used:— Bituminous: New River. Anthracite: screenings. Price per gross ton in bins: bituminous \$5.08 to \$5.13, screenings \$2.50. Average price per gross ton \$4.66. Per cent. ashes 12.2.

	CHESTNUT HILL PUMPING STATIONS.			
	No. 1.			No. 2.
	Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.	Engine No. 12.
Daily pumping capacity (gallons),	16,000,000	20,000,000	30,000,000	40,000,000
Coal consumed for year (pounds),	1,071,135	15,455	790,635	7,198,460
Cost of pumping, figured on pumping station expenses.	\$7,228.71	\$242.63	\$9,849.68	\$26,694.15
Total pumpage for year, corrected for slip (million gallons).	367.03	14.92	1,128.61	10,786.30
Average dynamic head (feet),	133.12	117.43	119.62	122.26
Gallons pumped per pound of coal,	342.66	965.38	1,427.47	1,498.42
Duty on basis of plunger displacement,	39,180,000	98,760,000	145,100,000	155,700,000
Cost per million gallons raised to reservoir,	\$19.6951	\$16.2621	\$8.7273	\$2.4748
Cost per million gallons raised one foot, . . . . .	.1479	.1385	.0730	.0202

	CHESTNUT HILL PUMPING STATION No. 2.	SPOT POND STATION.
	Engines Nos. 5, 6 and 7.	Engines Nos. 8 and 9.
Daily pumping capacity (gallons),	105,000,000	30,000,000
Coal consumed for year (pounds),	4,579,640	2,412,976
Cost of pumping, figured on pumping station expenses,	\$29,986.00	\$15,394.11
Total pumpage for year, corrected for slip (million gallons),	13,227.75	2,688.88
Average dynamic head (feet),	40.18	131.84
Gallons pumped per pound of coal,	2,888.38	1,114.34
Duty on basis of plunger displacement,	98,650,000	124,870,000
Cost per million gallons raised to reservoir,	\$2.2669	\$5.7251
Cost per million gallons raised one foot, . . . . .	.0564	.0434

Consumption.

Estimated total population of the eighteen cities and towns supplied wholly or partially during the year 1914,	1,134,180
Total consumption (gallons), pump basis,	38,882,770,000
Average daily consumption (gallons), pump basis,	106,528,000
Gallons per day to each inhabitant, pump basis,	93.9

Distribution.

	Owned and operated by Metropolitan Water and Sewerage Board.	Total in District supplied by Metropolitan Water Works.
Kinds of pipe used,	-1	-1
Sizes,	60-4 inch.	60-4 inch.
Extensions, less length abandoned (miles),	2.95	34.95
Length in use (miles),	119.05	1,813.95
Stop-gates added,	14	-
Stop-gates now in use,	506	-
Service pipes added,	-	3,882
Service pipes now in use,	-	171,884
Meters added,	-	11,109
Meters now in use,	-	107,704
Fire hydrants added,	-	556
Fire hydrants now in use,	-	16,443

¹ Cast-iron, cement-lined wrought-iron, cement-lined steel and kalamine pipe.

APPENDIX No. 4.

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

1.		2.	3.	AMOUNT OF BID.		6.
Number of Contract.		WORK.	Number of Bids.	4. Next to Lowest.	5. Lowest.	Contractor.
1	102 ¹	Reconstruction of part of Section 30, North Metropolitan System in Cambridge.	4	\$9,195 00	\$7,805 00 ²	Wm. J. Barry, Boston.
2	103 ¹	Section 70, New Mystic sewer, North Metropolitan System in Winchester.	8	39,116 50	37,555 00 ²	Ross and Barbaro, Winchester.
3	104 ¹	Section 68, New Mystic sewer, North Metropolitan System in Winchester.	5	77,748 20	67,535 00 ²	G. M. Bryne Co., Boston.
4	105 ¹	Section 48A, North Metropolitan System in Somerville and Medford.	8	2,101 40	1,876 75 ²	Antony Cefalo, Boston.
5	106 ¹	425 tons of coal for Alewife Brook pumping station.	1	-	\$5.15 per ton. ²	Locke Coal Company, Malden.
6	107 ¹	6,800 tons of coal:—	1	-	\$4.62 per ton. ²	Metropolitan Coal Co., Boston.
		2,700 tons for Deer Island pumping station.	1	-	\$4.54 per ton. ²	
		3,000 tons for East Boston pumping station.	1	-	\$4.54 per ton. ²	
		1,100 tons for Charlestown pumping station.	1	-	\$4.54 per ton. ²	
7	110	Part of Section 69, Station 0 to Station 23 + 0, New Mystic sewer, North Metropolitan System in Winchester.	7	34,975 00	\$33,360 00 ²	The Henry Spinach Contracting Co., Waterbury, Conn.
8	111	Part of Section 69, Station 23 + 0 to Station 49 + 69, New Mystic sewer, North Metropolitan System in Winchester.	4	61,365 75	53,616 00 ²	The Henry Spinach Contracting Co., Waterbury, Conn.
9	112	Section 57A, Revere Extension, North Metropolitan System in Chelsea and Revere.	8	3,368 70	3,360 00 ²	G. M. Bryne Co., Boston.
10	114	425 tons of coal for Alewife Brook pumping station.	1	-	\$5.15 per ton. ²	Locke Coal Company, Malden.

¹ Contract completed.

APPENDIX No. 4.

THE YEAR 1914 — SEWERAGE WORKS.

North Metropolitan System.

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1914.	10. Value of Work done Dec. 31, 1914.	
May 1, 1913	Aug. 16, 1913	- -	\$3,162 69	1
Apr. 9, 1913	May 4, 1914	- -	33,273 75	2
June 11, 1913	Dec. 31, 1913	- -	70,035 54	3
June 28, 1913	Aug. 23, 1913	- -	1,644 15	4
June 23, 1913	July 1, 1914	- -	2,086 19	5
June 23, 1913	July 1, 1914	- -	30,340 17	6
Jan. 2, 1914	Nov. 7, 1914	For earth excavation and refilling in trench and embankment for 42-inch concrete sewer, \$3 per lin. ft.; for Portland cement brick masonry in manholes and special structures, \$20 per cu. yd.; for Portland cement concrete masonry in trench and special structures, \$3 per cu. yd.; for spruce piles in trench in place, \$0.30 per lin. ft.	32,175 21	7
Jan. 2, 1914	Dec. 19, 1914	For earth excavation and refilling in trench and embankment for 36-inch concrete sewer, \$14 per lin. ft.; for Portland cement brick masonry in manholes and special structures, \$14 per cu. yd.; for Portland cement concrete masonry in trench and special structures, \$9 per cu. yd.; for spruce piles in trench in place, \$0.30 per lin. ft.	46,018 97	8
May 12, 1914	July 10, 1914	For earth excavation and refilling in trench for 15-inch vitrified pipe sewer, \$2 per lin. ft.; for Portland cement brick masonry in manholes, \$16 per cu. yd.; for Portland cement concrete masonry in trench, \$7.50 per cu. yd.	3,005 45	9
June 28, 1914	-	\$5.15 per ton of 2,240 pounds delivered in bins at Alewife Brook pumping station.	598 69	10

* Contract based upon this bid.

Contracts relating to the

1.	2.	3.	AMOUNT OF BID.		6.
			4.	5.	
Number of Contract.	WORK.	Number of Bids.	Next to Lowest.	Lowest.	Contractor.
11	115	6,900 tons of coal: — 2,700 tons for Deer Island pumping station. 3,000 tons for East Boston pumping station. 1,200 tons for Charlestown pumping station.	2 4.63 per ton. 3 4.51 per ton. 2 4.53 per ton.	3 3.98 per ton. ¹ 3.98 per ton. ¹ 4.24 per ton. ²	Gorman-Leonard Coal Co., Boston.
12	118 ¹	Repairing and furnishing doors, windows and moni- tors at East Boston pump- ing station.	1 —	3,675 00 ²	
13	119 ¹	Repairing existing skylights at East Boston pumping station and locker building.	1 —	695 00 ²		E. Van Noorden & Co., Roxbury.
14	121	New screen-house at East Bos- ton pumping station.	7 \$7,867 00	7,200 00 ²	J. Caddigan Company, Boston.

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID.		6. Contractor.	
			4. Next to Lowest.	5. Lowest.		
1	108 ¹	2,650 tons of coal: — 2,200 tons for Ward Street pumping station. 450 tons for Nut Island screen-house.	1	\$5.15 per ton. ¹	Metropolitan Coal Co., Boston.	
			1	-		
2	109 ¹	425 tons of coal for Quincy pumping station.	1	-	Frost Coal Company, Boston.	
				\$5.10 per ton. ¹		
3	113 ¹	Cast-iron pipe and special castings for Section 43, High- level sewer, South Metro- politan System in Quincy.	4	\$17,754 70	\$17,673 80 ²	Camden Iron Works, Camden, N. J.
4	116	2,650 tons of coal: — 2,200 tons for Ward Street pumping station. 450 tons for Nut Island screen-house.	2	\$5.15 per ton.	\$4.85 per ton. ¹	Gorman-Leonard Coal Co., Boston.
			2	\$4.79 per ton.	\$4.35 per ton. ¹	
5	117	450 tons of coal for Quincy pumping station.	2	\$4.98 per ton.	\$4.80 per ton. ¹	Frost Coal Company, Boston.
6	120	Section 43, Relief Outfall, High-level sewer, South Metropolitan System in Quincy.	8	\$36,310 00	\$34,790 00 ¹	W. H. Ellis & Son Co., East Boston.
7	122	Section 70, Siphon crossing, High-level sewer, South Metropolitan System in West Roxbury.	4	5,250 00	4,500 00 ²	Charles A. Haskin, Charlestown.

¹ Contract completed.

North Metropolitan System — Concluded.

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1914.	10. Value of Work done Dec. 31, 1914.	
June 26, 1914	-	\$3.98 per ton of 2,240 pounds delivered in bins at Deer Island pumping station. \$3.98 per ton of 2,240 pounds delivered in bins at East Boston pumping station. \$4.24 per ton of 2,240 pounds delivered in bins at Charlestown pumping station.	\$11,141 53	11
July 24, 1914	Dec. 11, 1914	For whole work, \$3,675.	3,675 00	12
July 25, 1914	Aug. 21, 1914	For whole work, \$695.	695 00	13
Oct. 1, 1914	-	For whole work, \$7,200.	4,250 00	14

THE YEAR 1914 — SEWERAGE WORKS — *Continued.**South Metropolitan System.*

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1914.	10. Value of Work done Dec. 31, 1914.	
June 23, 1913	July 1, 1914	- -	\$13,262 88	1
June 23, 1913	July 1, 1914	- -	1,578 86	2
July 15, 1914	Nov. 7, 1914	For 60-inch straight pipe, \$22.90 per ton of 2,000 pounds; for 60-inch pipe with turned spigots, \$23.40 per ton of 2,000 pounds; for 60-inch pipe with scored bells, \$23.40 per ton of 2,000 pounds; for special castings, \$65 per ton of 2,000 pounds.	17,799 90	3
June 26, 1914	-	\$4.85 per ton of 2,240 pounds delivered in bins at Ward Street pumping station. \$4.35 per ton of 2,240 pounds delivered on wharf at Nut Island screen-house.	4,264 42	4
June 26, 1914	-	\$4.80 per ton of 2,240 pounds delivered in bins at Quiney pumping station.	459 91	5
Aug. 29, 1914	-	For laying 60-inch cast-iron outfall pipes, \$18.42 per lin. ft.; for piling and masonry reinforcement of outlet, \$6,502; for Portland cement concrete masonry in trench, \$10 per cu. yd.	9,314 06	6
Nov. 21, 1914	-	For whole work, \$4,500.	-	7

* Contract based upon this bid.

CONTRACTS MADE AND PENDING DURING THE YEAR 1914 — SEWERAGE WORKS
— *Concluded.*

Summary of Contracts.

	Value of Work done Dec. 31, 1914.
North Metropolitan System, 14 contracts,	\$247,102 34
South Metropolitan System, 7 contracts,	46,680 03
Total of 21 contracts made and pending during the year 1914,	\$293,782 37

APPENDIX No. 5.

FINANCIAL STATEMENT PRESENTED TO THE GENERAL COURT
ON JANUARY 20, 1914.

The Metropolitan Water and Sewerage Board respectfully presents the following abstract of the account of its receipts, expenditures, disbursements, assets and liabilities for the year ending November 30, 1914, together with recommendations for legislation which it deems desirable, in accordance with the provisions of chapter 235 of the Acts of the year 1906.

METROPOLITAN WATER WORKS.

Construction.

The loans authorized for expenditures under the Metropolitan Water acts, the receipts which are added to the loan fund, the expenditures for the construction and acquisition of works, and the balance available on December 1, 1914, have been as follows:—

Loans authorized under Metropolitan Water acts, . . .	\$42,798,000 00	
Receipt from town of Swampscott for admission to Metropolitan Water District, paid into Loan Fund (St. 1909, c. 320),		90,000 00
Receipts from the sales of property which are placed to the credit of the Metropolitan Water Loan Fund:—		
For the year ending November 30, 1914, .	\$17,452 62	
For the period prior to December 1, 1913,	225,458 60	
		<hr/> 242,911 22
		\$43,130,911 22
Amount approved for payment by the Board out of the Metropolitan Water Loan Fund:—		
For the year ending November 30, 1914, .	\$149,916 91	
For the period prior to December 1, 1913,	42,236,474 52	
		<hr/> 42,386,391 43
Balance December 1, 1914,	\$744,519 79	

The amount of the Metropolitan Water Loan bonds issued at the end of the fiscal year was \$42,046,000, bonds to the amount of \$258,000 having been issued during the year. Of the amount issued, \$41,398,000 were sinking fund bonds, and the remainder, amounting to \$648,000, were issued as serial bonds.

At the end of the year the amount of the outstanding bonds was \$42,021,000, as bonds issued on the serial payment plan to the amount of \$25,000 had been paid. During the fiscal year, \$10,000 in serial bonds has been paid.

The Metropolitan Water Loan Sinking Fund amounted on December 1, 1914, to \$11,533,453.45, an increase during the year of \$767,940.80.

The net debt on December 1, 1914, was \$30,487,546.55, a decrease during the fiscal year of \$777,940.80.

Maintenance.

Amount appropriated for the maintenance and operation of works, for the year ending November 30, 1914,	\$450,551 91
Special appropriation for protection of water supply in aqueducts (1911) remaining, . . .	9,930 60
Special appropriations for protection and improvement of the water supply (1912 and 1913) remaining,	35,143 37
Receipts credited to this fund for year ending November 30, 1914,	50,607 73
	<hr/> \$546,233 61
Amount approved by Board for maintenance and operation of works during year ending November 30, 1914,	424,241 28
Balance December 1, 1914,	<hr/> \$121,992 33

This balance includes the sum of \$9,930.60, the amount remaining unexpended of the special appropriation for the protection of the water supply in aqueducts, and the sums of \$15,294.67, the amount remaining unexpended of the special appropriation in 1912, and \$19,848.70, of the special appropriation in 1913 for the protection and improvement of the water supply.

The Board has also received during the year ending November 30, 1914, \$50,607.73 from rentals, the sale of land, land products and power and from other proceeds from the operations of the Board, which, according to section 18 of the Metropolitan Water Act, are applied by the Treasurer of the Commonwealth to the payment of interest on the Metropolitan Water Loan, to sinking fund requirements, and expenses of maintenance and operation of works, in reduction of the amount to be assessed upon the Metropolitan Water District for the year.

Sums received from sales of water to municipalities not belonging to the District and to water companies, and from municipalities for admission to the District, have been applied as follows:—

For the period prior to December 1, 1906, distributed to the cities and towns of the District, as provided by section 3 of the Metropolitan Water Act,	\$219,865 65
For the period beginning December 1, 1906, and prior to December 1, 1913, applied to the Metropolitan Water Loan Sinking Fund, as provided by chapter 238 of the Acts of 1907, . . .	46,172 46
For the year beginning December 1, 1913, and ending November 30, 1914, applied to the Metropolitan Water Loan Sinking Fund, as provided by said last-named act,	5,396 65
	<hr/>
	\$271,434 76

METROPOLITAN SEWERAGE WORKS.

Construction.

The loans authorized under the various acts of the Legislature for the construction of the Metropolitan Sewerage Works, the receipts which are added to the proceeds of the loans, and the expenditures for construction, are given below, as follows:—

North Metropolitan System.

Loans authorized for expenditures for construction under the various acts, including those for the Revere, Belmont and Malden extensions, North System enlargements and extensions, New Mystic Sewer and Deer Island outfall extension,	\$7,144,365 73
Receipts from sales of real estate and from miscellaneous sources, which are placed to the credit of the North Metropolitan System:—	
For the year ending November 30, 1914,	184 20
For the period prior to December 1, 1913,	85,179 32
Amount approved for payment by the Board ¹ out of the Metropolitan Sewerage Loan Fund, North System:—	
For the year ending November 30, 1914,	\$139,750 67
For the period prior to December 1, 1913,	6,944,632 81
	<hr/>
	\$7,229,729 25
Balance December 1, 1914,	\$7,084,383 48
	<hr/>
	\$145,345 77

¹ The word "Board" refers to the Metropolitan Sewerage Commission and its successor, the Metropolitan Water and Sewerage Board.

South Metropolitan System.

Loans authorized for expenditures for construction under the various acts, applied to the construction of the Charles River valley sewer, Neponset valley sewer, High-level sewer and extension, \$8,867,046 27

Receipts from pumping, sales of real estate and from miscellaneous sources, which are placed to the credit of the South Metropolitan System:—

For the year ending November 30, 1914, 10 66

For the period prior to December 1, 1913, 14,081 35

Amount approved by the Board for payment as follows:—

On account of the Charles River valley sewer, \$800,046 27

On account of the Neponset valley sewer, 911,531 46

On account of the High-level sewer and extension:—

For the year ending November 30, 1914, 29,158 04

For the period prior to December 1, 1913, 7,109,993 95

\$8,881,138 28 \$8,850,729 72

Balance December 1, 1914, \$30,408 56

The amount of the Metropolitan Sewerage Loan bonds issued at the end of the fiscal year was \$15,880,912, no additional bonds having been issued during the year. Of the amount issued, \$15,440,912 were sinking fund bonds, and the remainder, amounting to \$440,000, were serial bonds.

At the end of the year the amount of the outstanding bonds was \$15,864,912, as bonds issued on the serial payment plan to the amount of \$13,000 had been paid during the year.

Of the total amount outstanding at the end of the year, \$6,987,000 were issued for the North Metropolitan System and \$8,877,912 for the South Metropolitan System. The Metropolitan Sewerage Loan Sinking Fund amounted on December 1, 1914, to \$3,011,512.44, of which \$1,922,492.30 was on account of the North Metropolitan System and \$1,089,020.14 was on account of the South Metropolitan System, an increase during the year of \$263,330.11.

The net debt on December 1, 1914, was \$12,853,399.56, a decrease of \$276,330.11.

Included in the above figures for the North Metropolitan System is \$440,000 in serial bonds issued under chapter 512 of the Acts of 1911, of which \$13,000 has been paid.

Maintenance.

North Metropolitan System.

Appropriated for the year ending November 30, 1914, . . . \$209,875 00
Receipts from pumping and from other sources, which are re-
turned to the appropriation:—

For the year ending November 30, 1914, 377 29

\$210,252 29

Amount approved for payment by the Board:—

For the year ending November 30, 1914, 186,479 86

Balance December 1, 1914, \$23,772 43

South Metropolitan System.

Appropriated for the year ending November 30, 1914, . . . \$114,070 00
Receipts from sales of property and for pumping, which are
returned to the appropriation:—

For the year ending November 30, 1914, 195 30

\$114,265 30

Amount approved for payment by the Board:—

For the year ending November 30, 1914, 107,002 43

Balance December 1, 1914, \$7,262 87

